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THE UNIVERSITY OF ALBERTA

AUDITORY DISCRIMINATION ABILITY OF CHILDREN IN KINDERGARTEN, GRADES ONE, TWO, AND THREE

by

ALAIRE GWEN OBERG

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

DEPARTMENT OF ELEMENTARY EDUCATION

EDMONTON, ALBERTA

SPRING, 1970

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Auditory Discrimination Ability of Children in Kindergarten, Grades one, Two and Three" submitted by Alaire Gwen Oberg in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

One of the problems facing educators over the years has been that of the child who fails to acquire facility in the process of reading. Reading is a complex process which involves many skills. Two of these are the ability to see letter differences in printed words, and, the ability to hear separate sounds in spoken words. Unless a child can associate the letter sounds with the corresponding printed symbols in learning to read, he will be faced with many difficulties in word perception. In order to make the phoneme-grapheme associations, children must be able to discriminate among speech sounds.

The purpose of this study was to compare the ability of children in kindergarten, grades one, two and three to discriminate between selected speech sounds and to determine whether there are significant differences in auditory discrimination performance among these grade levels. Information was also sought regarding specific auditory discrimination difficulties with selected speech sounds which children experience at these four grade levels.

The test sample of 160 subjects consisted of kindergarten, grades one, two and three children from two schools and two kindergartens in the city of Edmonton. Twenty boys and twenty girls at each grade level were selected randomly. One school and one kindergarten were from a high socio-economic area, and, one school and one kindergarten were from a low socio-economic area.

Tests that measured auditory discrimination, intelligence, and auditory acuity were administered to all subjects. Scores from the <u>California Short-Form Test of Mental Maturity</u> were used as measures of I.Q. The <u>Fast-Cosens Auditory Discrimination Test</u> was individually admini-

stered to determine the auditory discrimination ability of the subjects.

The data analysis consisted of computation of correlations, stepwise regression analysis, one-way analysis of variance, two-way analysis of variance, and an item analysis.

The findings revealed the progressive ability of pupils at each successive grade level to make auditory discriminations between selected speech sounds. Significant differences were found to exist between kindergarten and grade two, kindergarten and grade three, and, grade one and grade three. Performance of the total test sample indicated that stops were the most difficult sound type to discriminate whereas semivowel-lateral contrasts were least difficult. Voiceless sounds were more easily discriminated than voiced sounds. The subjects in the test sample found sounds in the final position most difficult to discriminate and sounds in the medial position least difficult when consideration was given to position of sound in words.

Correlation coefficients indicated that both chronological age and intelligence were significantly correlated to total pupil scores on the auditory discrimination test when the total test sample was considered.

Results of the two-way analysis of variance indicated that socio-economic status was a significant factor in pupil performance on the auditory discrimination test. Sex, however, was not a significant factor in the ability to auditorially discriminate.

On the basis of the findings in this study, ability in auditory discrimination appears to be a developmental process from kindergarten to grade three inclusive, as indicated by the gradual increase in mean auditory discrimination test scores at each successive level.

ACKNOWLEDGEMENTS

The writer wishes to express sincere appreciation to Dr. Jean Robertson, Chairman of the Thesis Committee, for her expert guidance and assistance in planning and carrying out this study. Appreciation is also extended to Dr. Myer Horowitz, Dr. Marion Jenkinson and Dr. Geraldine Farmer, members of the Thesis Committee, for their interest and counsel.

To Dr. George Cathcart, who so generously assisted with the statistical procedures in this investigation, a special thank you is extended.

The writer is indebted to Mrs. Isabel Schram for her faithful assistance and encouragement in collecting the research data in the schools.

Grateful appreciation is also extended to the pupils who participated in this study, their teachers, the school principals, and officials of the Edmonton Public School System. Without their cooperation, this study would not have been possible.

TABLE OF CONTENTS

CHAPTER PAGE

I. SCOPE AND SIGNIFICANCE OF THE PROBLEM. 1

Statement of the Problem. 1

Purpose of the Study. 4

Hypotheses. 5

Definition of Terms 6

Overview of the Study 8

Significance of the Study 9

Limitations of the Study. 10

Summary 10

II. THEORETICAL BACKGROUND AND RELATED STUDIES 11

The Importance of Auditory Discrimination in the

Reading Process. 11

The Interrelationship of Hearing, Speech and Reading 14

The Relationship of Auditory Discrimination to

Achievement in Reading 16

Comparison-Type Studies. 16

Correlational Studies. 18

Summary. 21

Socio-Economic Status and Auditory Discrimination . . . 22

Summary. 28

Sex Differences and Auditory Discrimination 28

Summary. 30

Intelligence and Auditory Discrimination. 30

Summary. 34

CHAPTER PAGE

Chronological Age and Auditory Discrimination 34

Summary. 35

Development of Auditory Discrimination. 36

Summary. 46

III. THE EXPERIMENTAL DESIGN. 47

The Sample. 47

Selection. 47

Socio-Economic Status of Subjects. 48

Testing Instruments 52

Auditory Tests 52

Auditory Acuity 52

Auditory Discrimination 56

<u>Fast-Cosens Auditory Discrimination Test</u>. 56

Intelligence. 62

Analysis of the Data. 66

Item Analyses. 66

Correlations 66

Stepwise Regression Analysis 67

One-Way Analysis of Variance 67

Two-Way Analysis of Variance 67

Summary. 68

IV. FINDINGS: THE ANALYSIS OF PUPIL PERFORMANCE ON THE
<u>FAST-COSENS AUDITORY DISCRIMINATION TEST</u>. 69

Pupil Performance by Grades on the <u>Fast-Cosens</u>
<u>Auditory Discrimination Test</u> 69

Performance of Pupils by Specific Sound Types 75

CHAPTER		PAGE
	Sound Contrasts.	75
	Most Difficult Sound Contrasts.	76
	Least Difficult Sound Contrasts	79
	Voicing.	81
	Position of Sound in Word.	86
	Like and Unlike Word-Pairs	93
	Most and Least Difficult Test Items as Indicated by Pupil Performance on the _Fast-Cosens Auditory Discrimination Test_.	95
	Most Difficult Test Items.	95
	Kindergarten.	95
	Grade One	97
	Grade Two	99
	Grade Three	101
	Summary.	103
	Least Difficult Test Items.	105
	Summary.	108
V.	THE COMPUTATION OF CORRELATIONS AND THE ANALYSES OF VARIANCE	112
	Findings of the Correlational Analysis.	112
	Summary.	116
	Stepwise Regression Analysis.	117
	Kindergarten	117
	Grade One.	119
	Grade Two.	119
	Grade Three.	120
	Summary.	121

CHAPTER PAGE

One-Way Analysis of Variance. 121

Specific Sound Contrasts 126

Voiced and Voiceless Sounds. 127

Sounds in Initial, Medial and Final Position . . . 128

Like and Unlike Word-Pairs 129

Summary. 130

Two-Way Analysis of Variance. 130

Summary. 135

VI. SUMMARY, CONCLUSIONS, IMPLICATIONS, AND SUGGESTIONS

FOR FURTHER RESEARCH. 136

Summary and Main Findings of the Study. 136

Null Hypothesis 1 138

Null Hypothesis 1(a) 139

Null Hypothesis 1(b) 139

Null Hypothesis 1(c) 140

Null Hypothesis 1(d) 140

Null Hypothesis 1(e) 141

Null Hypothesis 2 141

Null Hypothesis 3 142

Conclusions 143

Implications. 144

Suggestions for Further Research. 146

Concluding Statement. 148

BIBLIOGRAPHY. 150

CHAPTER PAGE

APPENDICES 157

Appendix A. Letter to Parents and Home Index Questionnaire 158

Appendix B. Administration of the Fast-Cosens Auditory Discrimination Test. 161

Appendix C. California Short-Form Test of Mental Maturity, Level 0 and Level 1 170

Appendix D. One Way Analysis of Variance 195

LIST OF TABLES

TABLE		PAGE
I.	Age at Which Speech Sounds are Mastered by Students As Reported by Templin, Wellman and Poole.	39
II.	Mean Chronological Age of Test Sample by Grades	48
III.	Mean Socio-economic Scores of Test Sample by Socio-Economic Status and Grade.	51
IV.	Hearing Impairment in Preschool Children.	55
V.	English Consonant Phonemes.	60
VI.	English Consonant Phonemes Compared in the Fast-Cosens Auditory Discrimination Test	61
VII.	Mean I.Q. Scores of the Test Sample As Measured By the California Short-Form Test of Mental Maturity. . . .	63
VIII.	Mean Chronological Age, S.E.S., I.Q., and Mental Age of Test Sample by Grade and Sex.	65
IX.	Performance of Pupils by Grades on the Fast-Cosens Auditory Discrimination Test	70
X.	Frequency Distribution of Pupil Scores on the Fast-Cosens Auditory Discrimination Test	74
XI.	Order of Difficulty of Types of Sounds on The Fast-Cosens Auditory Discrimination Test	77
XII.	Order of Difficulty of Voiced (vd) and Voiceless (vl) Types of Sounds on the Fast-Cosens Auditory Discrimination Test.	82
XIII.	Mean Performance of Pupils on Position of Sounds in Words on the Fast-Cosens Auditory Discrimination Test	87

TABLE PAGE

XIV. Order of Difficulty on Position of Sounds in Words on the Fast-Cosens Auditory Discrimination Test 88

XV. Composite Difficulty Indices of Position of Sounds in Words on the Fast-Cosens Auditory Discrimination Test. 90

XVI. Difficulty of Sound Types by Position of Sound in Words on the Fast-Cosens Auditory Discrimination Test 91

XVII. Performance of Pupils by Like and Unlike Word Pairs on the Fast-Cosens Auditory Discrimination Test 94

XVIII. Most Difficult Test Items as Measured by the Fast-Cosens Auditory Discrimination Test at End of Kindergarten. . 96

XIX. Most Difficult Test Items as Measured by the Fast-Cosens Auditory Discrimination Test at End of Grade One . . . 98

XX. Most Difficult Test Items as Measured by the Fast-Cosens Auditory Discrimination Test at End of Grade Two . . . 100

XXI. Most Difficult Test Items as Measured by the Fast-Cosens Auditory Discrimination Test at End of Grade Three . . 102

XXII. Difficulty Indices by Grades of Most Difficult Test Items as Measured by the Fast-Cosens Auditory Discrimination Test at the End of Grade Three 104

XXIII. Difficulty Indices by Grades of Most Difficult Test Items as Measured by the Fast-Cosens Auditory Discrimination Test at End of Kindergarten. 106

XXIV. Least Difficult Test Items as Measured by the Fast-Cosens Auditory Discrimination Test at End of Kindergarten. . 107

TABLE		PAGE
XXV.	Difficulty Indices by Grades of Least Difficult Test Items as Measured by the Fast-Cosens Auditory Discrimination Test at End of Kindergarten	109
XXVI.	Correlations of Variables	114
XXVII.	Analysis of Variance in Stepwise Regression Analysis for Kindergarten Pupils' Scores.	118
XXVIII.	Test Variance Due to Socio-Economic Status, Intelligence, Chronological Age, and Sex in Kindergarten, Grades One, Two, and Three.	122
XXIX.	Performance of Pupils by Grades on the Fast-Cosens Auditory Discrimination Test	124
XXX.	Scheffé Multiple Comparison of Means on the Fast-Cosens Auditory Discrimination Test	125

LIST OF FIGURES

FIGURE PAGE

1. Mean S.E.S. Scores by Grades. 53

2. Distribution of Scores on the Fast-Cosens Auditory Discrimination Test. 72

3. Correlation Between Chronological Age and Criterion Score 115

4. Mean Performance of Pupils by Grades on the Fast-Cosens Auditory Discrimination Test 123

5. Mean Scores on the Fast-Cosens Auditory Discrimination Test by Grade and Sex. 131

6. Mean Scores on the Fast-Cosens Auditory Discrimination Test by Grade and Socio-Economic Status. 133

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CHAPTER I

SCOPE AND SIGNIFICANCE OF THE PROBLEM

I. STATEMENT OF THE PROBLEM

Although auditory discrimination as a factor in reading has been a topic for much discussion, research in this area has been limited. Yet, in spite of the latter, educators seem to agree that the ability to discriminate between speech sounds is a basic factor in reading readiness and in subsequent reading development (King, 1969; Clark and Richards, 1966; Deutsch, C., 1964; Goins, 1959).

The regard for the importance of reading in the educational process is evidenced by the vast amount of literature which is being published in this area today. It has been said that "few people would challenge the statement that reading is the most important subject in the curriculum of the elementary school" (Schonell, 1948:122). He further stated that not only does success in reading, to a large extent, condition a child's progress in most of the other subject areas, but it influences the whole attitude of the pupil towards school. Labrant (1964:214) describes reading as a life-long process which is "initiated in the elementary school, continued through the remaining years of schooling, and maintained through adult life with continuous growth."

It has been suggested that we should identify the characteristics, attitudes and habits of the successful reader and consider how we may exploit them in our reading programs. Consequently, over the past four decades much research has been devoted to identifying and investigating factors which are believed to be associated with success and failure in reading achievement. Among the factors suggested is that of auditory discrimination.

Auditory discrimination, in the child learning to read, is generally regarded as the capacity to distinguish between phonemes or individual sounds in speech. Gleason (1967:9) has defined a phoneme as a

> minimum feature of the expression system of a spoken language by which one thing that may be said is distinguished from any other thing which might have been said. Thus, if two utterances are different in such a way that they suggest to the hearer different contents, it must be because there are differences in the expressions. The difference may be small or extensive. The smallest difference which can differentiate utterances with different contents is a difference of a single phoneme (Gleason, 1967:9).

As children begin to learn to read it is generally standard practice that they learn to recognize a few printed words that they use orally in their speaking vocabularies. These beginning words in reading are learned one by one in meaningful situations and generally come from the children's own conversation in class. The oral context in which they are used assists the child to understand their meaning.

Learning to read these few initial words is not solely rote memorization, but is the result of a composite procedure by which, in the very early stages of reading instruction, children begin to identify printed words. These words are usually referred to as "sight words". They are words that once learned will be recognized whenever they are seen. With the learning of these sight words, the children are beginning to use skills with which they will soon be able to figure out other words that they will meet in their reading each day.

There is a limit to the number of words that a child can visually recall by memory of word form, however. This, then, necessitates the introduction of other approaches to the identification of words. These approaches consist of gradually learning to associate sounds with their corresponding letter symbols within words, as in phonics and structural

analysis. In order to make these phoneme-grapheme associations, the child must be able to discriminate among speech sounds. Therefore in learning to read, the beginning reader relies heavily on auditory clues.

Investigations of audition and reading were limited in number until approximately the year 1940. However, an awareness of educators and researchers of the prevalence of auditory inadequacies and of their possible significance to the process of learning has led to an increase in the number of studies in this area.

While many of the early studies were in the area of auditory acuity and reading (Kennedy, 1942; Henry, 1947), the later ones, while including auditory acuity, have investigated other auditory factors such as auditory discrimination, auditory memory span and auditory blending (Poling, 1968; Cosens, 1968; Fast, 1968; Carrans, 1968; Reid, 1962). As a result of these studies, several researchers have postulated that auditory discrimination may be a developmental process (Poling, 1968; Thompson, 1963; Wepman, 1960).

It has been stated that some children do not seem to develop the capacity to discriminate between similar sounds until they are about eight years of age, regardless of their mental age (Goins, 1959:11). This has important implications for reading instruction in the primary grades. Unless a child can associate the letter sounds with the corresponding printed symbols in learning to read, he will be faced with many difficulties in word perception. Therefore, since research has suggested that there may be developmental aspects of auditory discrimination, it is important that studies attempt to determine if there are differences in the ability of young children to discriminate among speech sounds at different grade levels.

II. PURPOSE OF THE STUDY

The purpose of this study was to compare the ability of children in kindergarten, grades one, two and three to discriminate between selected speech sounds, and, to determine whether there are significant differences in auditory discrimination performance among these grade levels. Information was also sought regarding specific auditory discrimination difficulties in selected speech sounds at the selected grade levels. It was recognized that to establish the proposition that auditory discrimination is developmental, the most defensible type of study would have been one of a longitudinal nature. In such an investigation, each subject would have been tested as to discriminatory ability at successive grade levels. The trend of the scores would have indicated the developmental aspects of auditory discrimination.

However, longitudinal studies by their very nature present problems because of the delay before findings are available, and also because of the difficulty of keeping intact for an extended period of time a representative sample. In view of these difficulties, the present study attempted to examine the question of the development of auditory discrimination by using representative samples at the various grade levels. Any conclusions, regarding the developmental nature of auditory discrimination, are conditional upon the validity of the assumption inherent in this approach.

Precisely, it was assumed that the performance of the grade one group represented how the present kindergarten group would have performed a year later: that the grade two group was indicative of the performance by the kindergarten groups two years hence, and similarly for the grade three group. If the pupil samples are in fact truly random and

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representative of the respective grade levels, then the existence of this underlying assumption would not appear to present serious doubts regarding the conclusions which are presented.

III. HYPOTHESES

The following hypotheses were formulated and tested:

1. Among children in kindergarten, grades one, two and three, there are no significant differences in their ability to make auditory speech discriminations as indicated by their
    a. total test scores on the Fast-Cosens Auditory Discrimination Test.
    b. subtest scores on test items measuring the following sound type contrasts:
        (1) stop-stop contrasts
        (2) nasal-nasal contrasts
        (3) semivowel-lateral contrasts
        (4) fricative-fricative contrasts
        (5) affricate-fricative contrasts
        (6) fricative-stop contrasts
        (7) semivowel-semivowel contrasts,
    c. subtest scores on test items measuring voiced and voiceless sounds,
    d. subtest scores on test items measuring sounds in the initial, medial and final position, and
    e. subtest scores on test items measuring like and unlike word-pairs.

2. In analyzing auditory discrimination scores there is

   a. no significant interaction between grade and sex,

   b. no significant main effect due to sex,

   c. no significant interaction between grade and socio-economic status, and

   d. no significant main effect due to socio-economic status.

This hypothesis will consider the total Fast-Cosens Auditory Discrimination Test score only.

3. There is no significant correlation between ability of children to make auditory speech discriminations and

   a. intelligence,

   b. chronological age in months.

IV. DEFINITION OF TERMS

For the purpose of this study the meaning attached to certain terms is as follows:

1. Auditory Discrimination

Auditory discrimination is defined as the "ability to detect likenesses and differences in speech sounds and to recognize the component sounds in a word and their order" (Gunderson, 1969:536).

2. Kindergarten

Kindergarten refers to a group of preschool children receiving instruction as required by the Department of Education, Government of Alberta, in their Kindergarten Manual.

3. Grade One

Grade one refers to pupils in their first year of school.

4. Grade Two

Grade two refers to pupils in their second year of school.

5. Grade Three

Grade three refers to pupils in their third year of school.

6. Grades

In this study, grades include kindergarten, grades one, two and three.

7. Socio-Economic Status (S.E.S.)

This refers to the level indicative of both the social and the economic achievement of an individual or group as computed by combining ratings from the Blishen (1968) Socio-Economic Index for Occupations and a modified form of Elley's (1961) revision of the Gough Home Index Scale.

8. Intelligence Quotient (I.Q.)

This refers to the current functioning level of intelligence as determined by the California Short-Form Test of Mental Maturity. The operational definition of Intelligence in the present study shall be interpreted to include the intelligence quotient.

9. Mental Age (M.A.)

Mental age refers to the measurement of the mental level of an individual in terms of the average, chronological age of children showing the same mental standard as measured by a scale of mental tests.

10. Chronological Age (C.A.)

This refers to the age determined from the date of birth.

11. Developmental

For the purpose of this study, developmental refers to changes in the ability of the kindergarten, grades one, two or three pupils to make auditory discriminations between speech sounds under the conditions set forth in section two, Chapter I.

V. OVERVIEW OF THE STUDY

The test sample consisted of kindergarten, grades one, two and three children randomly selected from two schools and two kindergartens designated by officials in consultation with the investigator. Twenty boys and twenty girls at each grade level were selected using a table of random numbers, thus yielding a total test sample of 160 subjects.

One school and one kindergarten were from an area designated as serving families of high socio-economic status, and, one school and one kindergarten were from an area designated as serving families of low socio-economic status.

The following data were collected for each subject:

1. A Maico Portable Audiometer was used by the investigator during the first two weeks of May to individually test the auditory acuity of each subject, and to determine the hearing loss, if any, of the child.

2. Along with a covering letter, a modified version of Elley's (1961:105) revision of the Gough Home Index Scale, with the questions reworded so that they could be answered by parents, was sent to the parents of all subjects in the test sample. By combining this rating with the rating determined by using Blishen's (1968:741-753) Socio-Economic Index for Occupations, a socio-economic score was obtained for each subject.

3. An intelligence quotient for each pupil was obtained by administering the California Short-Form Test of Mental Maturity to small groups during the month of May.

4. The Fast-Cosens Auditory Discrimination Test was used to measure the ability of each subject to discriminate between word-pairs, some pairs in which the same word was repeated and some in which different words were presented together. The test was administered to each subject individually.

   All data was numerically coded and punched on IBM cards for computer analysis. The data collected was processed using the following statistical techniques: item analyses, one-way and two-way analyses of variance, and computation of correlations.

VI. SIGNIFICANCE OF THE STUDY

It is generally agreed that reading is a highly skilled activity necessitating the integration of a number of mental processes. The child learning to read sees a succession of shapes, the letters, which are combined in groups, the words. At some point in learning to read the child is taught that each of these shapes is associated with a sound or sounds, and that a combination of these sounds constitutes the total sound of the word (Vernon, 1959:2). We might say that the process of reading is dependent upon an association between speech sounds and printed symbols. However, research has indicated that "some children do not seem to develop the capacity to discriminate among similar speech sounds until they are about eight years old, regardless of mental age" (Goins, 1959:11).

It is hoped that as a result of this study, any information indicating the maturational sequence in the development of auditory discrimination will help classroom teachers to provide an auditory readiness program which meets the needs of children in learning to read.

In addition to this, if insight is gained into some pattern of development in the auditory discrimination of types of speech sounds and specific speech sounds, programs designed to help those children with auditory discrimination deficiencies should have an impact on reading achievement generally.

It is also hoped that this study will indicate whether there is a need for audiometric testing at the beginning of grade one as previous research has recommended (Cosens, 1968; Reid, 1962).

VII. LIMITATIONS OF THE STUDY

The study possesses the following limitations:

1. There are some sounds whose auditory discrimination is not being tested.
2. The phonemic environment of sounds is not being investigated in the present study. Whether a certain vowel follows the consonant or precedes it may play an important part in determining whether or not the subjects can distinguish between the word pairs (Calfee and Venesky, 1968:106).
3. A cross-sectional study always offers limitations when one attempts to determine possible growth factors. Before the nature of any change or growth of auditory discrimination can be studied in detail, a longitudinal study must be made.

VIII. SUMMARY

This chapter has attempted to introduce the problem, provide a brief theoretical background to the study, state the purpose, limitations, significance and design of the study, define the terms and state the hypotheses. It has also attempted to show the need for a study to investigate the ability of young children at successive grade levels to discriminate between speech sounds.

CHAPTER II

THEORETICAL BACKGROUND AND RELATED STUDIES

The purpose of this chapter is to provide a background for the investigation of young children's ability to discriminate between speech sounds. Research findings which have made a contribution to what is known about the relationship of auditory discrimination and reading will be reviewed. Section I will show the importance of auditory discrimination as it relates to the reading process. Section II will be concerned with studies which were devised to investigate the relationship of auditory discrimination to achievement in reading. Studies which have investigated socio-economic status, sex, intelligence and chronological age as they relate to auditory discrimination will be reviewed in sections III, IV, V and VI. Section VII will be devoted to a review of studies, as a result of which researchers have postulated that auditory discrimination is developmental.

I. THE IMPORTANCE OF AUDITORY DISCRIMINATION IN THE READING PROCESS

Reading has been described as the "perception and comprehension of written messages in a manner paralleling that of the corresponding spoken messages" (Carroll, 1964:337). Therefore, as has been often stated, any method of teaching reading must relate the written message to spoken language, and this presupposes adequate auditory perception skills for apprehending the spoken language.

The importance of auditory perception skills in beginning reading has been stressed by Durrell (1956:42). He emphasizes that success in the early stages of reading necessitates the ability to hear the

separate sounds in words that children speak or hear. This view has been similarly expressed by Dechant (1964:143), who states that a child must be able to "discriminate the phonetic elements that make up the word" if he is to make the correct association between the spoken and written word.

Authorities in reading instruction generally agree that there are two major tasks to be performed in the complex process of reading (Lee, 1969:403). First, the reader must recognize and understand the printed word on the page. Secondly, he must interpret, assimilate and integrate the specific meanings intended in the passage.

Gray (1960:10), in his model of reading, sets forth four main components of the reading process:

1. Word perception;
2. Comprehension of the ideas represented by the words;
3. Reactions to these ideas; and
4. Assimilation or integration of the ideas with previous knowledge or experience.

It has been pointed out that, while each of these aspects is set forth separately, they do operate simultaneously and reading must be considered a unitary act (Clymer, 1968:23).

Word perception is considered to be the most fundamental of the four reading components, and auditory discrimination, or the ability to hear the differences between speech sounds, is an important part of the word perception program.

The first printed words that a child learns to recognize are usually words that are familiar to him which are presented as wholes in context. Huey (1908:102-116), a pioneer in investigating perception,

and several others who have conducted similar investigations, seem to agree that in the majority of cases, the general form characteristics of a word are the clues by which it is recognized. However, when the words are unknown, it is necessary to introduce other systematic procedures in the identification of words. One of these procedures consists of learning to relate the letter, or letters, in the printed word to the sounds in the spoken word, as in phonics analysis. This requires not only the ability to recognize the shapes of separate letters and the sounds they represent but also the ability to segment spoken words into the sounds that correspond in sequence to letters or groups of letters. Therefore, the relationship between auditory discrimination and the acquisition of word perception skills is a most important aspect of the reading process.

Jaranko (1969:503) has expressed his views on the importance of auditory discrimination in the reading process especially during the first three years in school. He states that many intelligent children with a good memory, who have been instructed through a visual method, are able to maintain a satisfactory standard of achievement in reading during the first two years. However, at the grade three level, when the instructional pace increases considerably, the vocabulary load becomes too great for the child to deal with visually. His memory for new words has reached its limit. Jaranko (1969:508) states that the child who depends solely upon his visual powers to read is doomed to failure unless he develops independent word recognition skills which include the ability to make the sound-symbol relationship.

Studies have shown that two of the skills needed in acquiring a reading vocabulary can be advantageously taught to children prior to

formal reading instruction. These skills are the ability to hear separate sounds in spoken words and the ability to see letter differences in printed words (King, 1969:552). She suggests that children at school entrance age have rarely learned to make the very fine speech discriminations that are required for efficient progress in learning to read.

The Interrelationship of Hearing, Speech and Reading

The importance of auditory discrimination in the reading process is recognized by other researchers, also. Deutsch, C. (1964:293) who contends that "a particular minimum level of auditory discrimination skill is necessary for the acquisition of reading and of general verbal skills" believed that many reading-readiness programs emphasize readiness in terms of visual skills rather than auditory ones. Moreover, Blank (1968:1091) points out that research on reading retardation indicates that ability in reading, which would seem to be a basically visual task, is often more highly correlated with auditory than visual performance.

According to Gray (1960:33), a child should be able to hear a given sound accurately and be able to produce this sound in his own speech before he is asked to associate that same sound with a printed letter or letters. This view is supported by Wepman (1961:245-247) who states that hearing, speech and reading are interrelated. He postulates that the ability to discriminate sounds is a developmental process, which is evidenced by the number of children who show discriminatory power at each higher age level.

If, as Wepman (1960:327) suggests, hearing comes to maturity at different rates during the first three years of school, the teacher, by understanding the relationship between hearing, speaking and reading, and,by adapting instruction to meet the specific needs of the child,

can offset some of the problems that children encounter in the process of learning to read. It is therefore important that teachers be aware of the auditory maturation of the pupil, one aspect of this maturation being the ability to discriminate among speech sounds.

Templin (1957:53) has reported her findings along with those of Poole (1934) and Wellman (1937) in which the articulation of speech sound in words, of children aged three to eight, were investigated. The findings indicated that the acquisition of speech sounds is a developmental process. Although the studies show slight differences in the order of development, they agree that normal acquisition of speech is as late as the seventh year of age for children generally. Perhaps then, the sounds which children cannot articulate correctly are those not accurately discriminated by young children. Therefore, it may be that auditory discrimination, also, is developmental.

Several researchers in the field of reading have postulated that auditory discrimination is developmental. Wepman (1960:327) contends that both the discrimination and articulation of speech sounds results from the developing process of auditory maturation. This, as it relates to the reading process is particularly important. Inadequate development could result in the child not being able to make the necessary fine discriminations in speech. Consequently, he would be unable to make the correct association between the spoken and printed word.

The auditory perception of word sounds and their association with printed shapes cause considerable difficulty for many children in the initial stages of learning to read (Goins, 1959:12). She suggests that when a child enters grade one, words are just part of a total pattern of meaning, but eventually his auditory perceptions become more

refined to the points that he perceives

(1) that each word's pattern of sound is a unit in itself,

(2) that the sound pattern of each word is a succession of sounds, always in the same order,

(3) that these sounds occur in other words, but in a different order in different words,

(4) that the sounds correspond to letter shapes, and

(5) that the sound-symbol relationship in English is irregular and varies from word to word.

It would seem then, that auditory discrimination, the ability to distinguish between speech sounds, is most important in the complex task of learning to read. Consequently, it has been the subject of many research studies.

II. RELATIONSHIP OF AUDITORY DISCRIMINATION AND READING ACHIEVEMENT

One method of attempting to determine the relation of skill in auditory discrimination to ability in reading has been to investigate differences in auditory functioning of groups of "good" and "poor" readers. This technique uses pairs of individuals matched with respect to sex, intelligence, age and other similar factors. The only discrepancy is in reading ability. One member of each pair is a normal reader and the other member is a disabled reader. Following the matching procedure, various measures of auditory discrimination are administered to both the normal and the disabled reader and differences in auditory skill are analyzed.

Comparison-Type Studies

One of the earliest studies of this type, widely quoted in reading

research, was reported by Bond (1935:1-45). Sixty-four pairs of pupils from grades two and three were matched in terms of age, intelligence, sex and school experience. Each pair differed primarily in reading achievement. The disabled or poor readers were retarded by at least one-half year if enrolled in grade two, and by at least one year if in grade three. All pupils were administered typical measures of word-pair discrimination, auditory blending as well as tests of auditory acuity. Results of this investigation showed significant differences between the "good" and "poor" readers in auditory discrimination as well as in the other auditory perception tests.

Although the matching design does provide groups which are similar on several factors, this technique necessitates having an extremely large test population. Furthermore, in some instances, by utilizing the matching procedure, many subjects are eliminated from the study with the result that one cannot assume that the test sample is truly random.

Using the matching technique, Wolfe (1941:57-69) investigated the auditory discrimination ability of two groups of nine-year old boys. He found that the group of disabled readers was significantly inferior to a group of average readers in the ability to discriminate between word-pairs.

Monroe (1939:93) was among the first researchers to suggest that reading disability might be associated with an inability to discriminate successfully the sounds of words. Using similar measures of auditory perception to those used by Wolfe (1941:59-69), she compared pupils in a regular grade one classroom with thirty-two grade one nonreaders. The latter group was significantly inferior in the ability to discriminate between word-pairs.

Other researchers have made studies of disabled readers in clinical situations in which the investigator collects data on individual subjects over a period of years. In this way it is possible to postulate various correlates of reading disability. Schonell (1948:175) who studied backward readers for over a period of eight years reported that 38 per cent of these subjects manifested some degree of deficiency in auditory discrimination.

Another study, utilizing the data from reading disability cases at the University of Chicago Reading Clinic between 1944 and 1949 was reported by Poling (1953:107-111). On the basis of performance on an auditory discrimination test which was administered to seventy-eight subjects composed of twenty girls and fifty-eight boys, subjects were divided into levels. The "high" group consisted of thirty pupils who achieved a percentile rank of seventy or above on the test. The low group consisted of ten pupils who ranked below the thirtieth percentile on the same test. Comparisons were then made between the two groups with respect to the number and type of errors made by each. No significant differences in types of errors were found on any of the tests. Those pupils who possessed low auditory discrimination ability were no more likely to make vowel, consonant, or reversal errors, or to add or omit sounds in words than were the pupils with a greater degree of ability in auditory discrimination. Upon this basis, it was concluded that auditory discrimination is not a widespread causal factor of inefficient word recognition. However, a recent longitudinal study by Poling (1968:141) indicated that auditory discrimination ability is significantly related to reading achievement.

Correlational Studies

Recent correlational studies whereby an attempt was made to establish a relationship between reading ability and auditory discrimina-

ation have been reported by several researchers. An extensive evaluation of the relation of auditory discrimination skill to reading ability was conducted by Wheeler and Wheeler (1954:103-113). Tests were administered to 629 pupils in grades four, five and six, in which each subject was required to:

(1) discriminate between word-pairs,

(2) discriminate between paired sound elements,

(3) discriminate rhyming words, and

(4) discriminate sounds within words.

Results of Wheeler's and Wheeler's (1954:113) study indicated that auditory discrimination was significantly related to reading achievement. Educators generally agree that the ability to discriminate between speech sounds is a basic factor in the beginning stages of reading. Durkin (1966:33) points out that the beginning stages of reading are not confined to a given grade level or age level. She reminds us that any discussion of initial reading must include any child of any age who is learning to read. "There are children enrolled in the middle and upper grades who are beginners in reading, just as there are younger children in the first and second grade who are far beyond the beginner classification". Consequently, research in auditory discrimination has been done at all levels of formal school education.

Another correlational study is that of Reynolds (1953:439-449) who made an extensive survey of the auditory characteristics of 186 grade four pupils. He found that auditory blending was unrelated to general reading ability and only slightly related to word recognition skills. However, auditory discrimination which involved differentiating between word-pairs was more highly correlated with all aspects of reading achievement.

Several studies involving the factor of auditory discrimination have been done at Boston University. Durrell and Murphy (1953:556-560) investigated the relationship of ability to identify sounds in spoken words to reading achievement in grades one, two and three. Correlations were reported to be .56, .52, and .52 in grades one, two and three respectively. They concluded, on the basis of this and a number of related studies, that the ability to identify the separate sounds in spoken words is a most important factor in determining a child's success in learning to read.

Tests of ability to notice initial consonant sounds, rhyming at the end of words, final consonants in words spoken by the investigator were administered to about 500 grade two children in a study reported by Harrington and Durrell (1955:375-380). A group of pupils whose auditory discrimination scores were high was matched on mental age, visual discrimination and phonics ability with a group who made low scores. The reading vocabulary of each group was compared. The group with superior auditory discrimination was also significantly superior in reading vocabulary. Results of the study indicated that specific instructions in phonics and in visual and auditory perception of word elements is essential to success in building reading vocabulary in the primary grades.

From a study concerned with auditory and visual perception training, LaPray and Ross (1967:530-532) concluded that part of the children's difficulty in learning to read started with the inability to hear sounds and attach proper meanings to the sounds. Consequently, an attempt was made to assess how accurately a child perceives sounds by measuring the following:

(1) the ability to discriminate between like and different sounds,

(2) the ability to blend sounds together into a meaningful unit,

(3) the ability to identify differences in inflectional and intonational patterns, and

(4) the ability to reproduce similar inflectional and intonational patterns.

Results of their findings seem to indicate that children who do poorly on the auditory perception test tend to do poorly in basic-reading skills.

One of the most recent and extensive investigations in the area of auditory discrimination is that by Dykstra (1966:5-35). He administered seven auditory discrimination measures from various published reading readiness tests to 632 grade one children at the beginning of the school year. In May, at the end of the school term, he administered the Word Recognition and Paragraph Meaning subtests of the Gates Primary Reading Test to the same subjects. Correlational coefficients between the auditory discrimination measures and the reading test scores ranged from .19 to .43. With the use of all the above measures, between 32 and 38 per cent of the variance in reading achievement could be predicted.

Summary

The foregoing studies have indicated that auditory discrimination is an important factor which affects or influences success in learning to read. The findings of research, as cited, have suggested that poor readers tend to be immature in auditory discrimination ability. The fact that many investigations have indicated that there is a relationship between ability to make auditory discrimination and reading achievement would suggest auditory perceptual training should be an integral part of

the regular reading program.

III. SOCIO-ECONOMIC STATUS AND AUDITORY DISCRIMINATION

A great deal of attention has been directed toward the child whose family and community background have not prepared him adequately to cope with the demands of the school curriculum when he enters school. Numerous labels have arisen through attempts by many to arrive at an all-embracing definition of the lower classes. These include disadvantaged, underprivileged, culturally deprived and low socio-economic group. The socio-economic level of the family is certainly beyond the control of the learner. Nevertheless, studies by David (1960:39-42) revealed that social class not only influences performances on intelligence tests, but affects the range and type of vocabulary used by the child, as well as his interests and behaviour.

According to Deutsch, M. (1963:249-263) children from lower class homes begin school with certain inadequacies in language development. Research has shown that the language development of children is a function of numerous factors including provision for an appropriate language model, the opportunity for parent-child interaction, dialect differences in the home and school, and socio-economic level (Ruddell, 1967:420).

Within the lower-class home there is often limited verbal-interaction and directed speech sequences. Any verbal communication is likely to be terse, limited in vocabulary and grammatically simple. This view is supported by Bernstein (1961:163-176) who has delineated the characteristics of a "public" language, the major speech form of the lower working class.

According to Strang (1951:148) a cultural background devoid of

meaningful experiences leads to inappropriate speech habits. Not only does the lower-class child have a restricted background of experiences, but he is not likely to have derived any great amount of meaning from those experiences he has had. No one has guided his perceptions of things he has experienced and he rarely has the opportunity to manipulate verbally his ideas about them. As Mills (1967:346) has said "The young disadvantaged child is a language cripple. He is not, strictly speaking a non-verbal child; but his verbal inadequacies are such that they present a grave threat to his success in learning to read." It is within this context that low socio-economic status has been associated with the terms disadvantaged, culturally deprived and underprivileged.

If reading achievement depends greatly upon language facility, and if language facility is related to socio-economic background, then children from low socio-economic status groups constitute a very serious problem.

Raph (1965:396-376) has summarized her analysis of studies, which investigated the language development of socially disadvantaged children, by the following statement:

> "Language acquisition in contrast to that of middle class children is more subject to a lack of vocal stimulation during infancy, to a paucity of experience in conversation with more verbally mature adults in the first three or four years of life. . . . Distinctive qualities of their language and speech include a deficit in the auditory-vocal modality greater than in the visual-motor areas, a meagerness of quantity and quality of verbal expression which serves to depress intellectual functioning as they grow older, and a slower rate and lower level of articulatory maturation."

Consequently, research has indicated that the auditory discrimination skills of lower-class children are well below their middle class peers.

Edwards (1965:547) has pointed out that culturally deprived children display weaknesses in auditory discrimination. He explained that auditory discrimination develops within a particular environment in which a particular system of speech sounds prevails. The child becomes accustomed to hearing and reproducing the speech sounds of his environment. There is a tendency toward perceptual distortion when the socially disadvantaged child hears a "new" sound and attempts to reproduce it in accordance with its nearest equivalent within his more familiar speech-sound system. This hampers the learner in his development of word-recognition skills in reading. He has difficulty making the sound-symbol relationship because he has never really mastered the spoken counterpart as required by the school.

As Deutsch, C. (1964:277-296) has stated, it is quite possible to have intact hearing organs and still be unable to discriminate differences in the stimuli. This is especially so when experience has been limited as in the lower-class home in which language is used in the most restricted sense. She continued by stating that "it is only through experience which involves consistent exposure to particular auditory stimuli" that a child comes to discriminate sounds, to recognize words and relate them to referents, and eventually to use words himself. The interrelationship between hearing and speech is thus well established.

Using grade one children Deutsch, M. (1963:249-263) found lower class children significantly below middle class children in auditory discrimination ability when tested against middle class standards. His data further indicated that poor readers within social class groups have significantly more difficulty in auditory discrimination than do good readers, with the differences being greater for the lower classes.

Upon the basis of the previous study, Clark and Richards (1966: 259-262) investigated the differences in auditory discrimination ability of economically disadvantaged and non-disadvantaged preschool children. The sample consisted of (1) twenty-nine economically disadvantaged children enrolled in the Headstart Program at the University of Wisconsin and (2) twenty-nine non-disadvantaged children enrolled in the same program but paying tuition. In order to ensure consistency of presentation, the Wepman Auditory Discrimination Test was administered to the fifty-eight subjects, individually, from a tape recording. Clark and Richards (1966:261) concluded that when compared to a nondisadvantaged group, preschool economically disadvantaged children exhibit significant deficiencies in auditory discrimination ability. The investigators suggested that, in addition to the factor of economic deprivation, a most evident and relevant variable in this study was motivation for attending to the task.

Another study which investigated the auditory perception of children was that of La Pray and Ross (1967:530-532). The sample consisted of sixty grade one pupils who were in the bottom quartile of their classes. Tests were administered to measure the ability (1) to discriminate between like and different sounds (2) to identify likenesses and differences in inflectional and intonational patterns. The findings indicated that children from the middle and upper-class schools did better than the children from lower-class schools. In addition to this, children who performed poorly on the auditory perception test tended to do poorly in basic reading skills.

Statements such as the following reflect the view that has motivated studies of auditory discrimination ability of the culturally

disadvantaged child:

> "Slum youngsters may lack the sense of auditory discrimination - the ability to distinguish very subtle differences and nuances in sound - that is essential to reading" (Silberman, 1964:38).

Using low socio-economic children, Silveroli and Wheelock (1966:247-251) conducted a study in Phoenix, Arizona, to investigate whether these pupils were able to discriminate speech sounds and whether they need auditory discrimination training. A random selection was made to determine experimental and control groups, consisting of sixty pupils in each. Within the experimental group, sub-groups designated as Auditory Discrimination Training (1) (ADT1) and Auditory Discrimination Training 2 (ADT2) were arbitrarily established. The purpose of the study was limited to answering two questions, namely: (1) Will auditory training help the beginning reader in lower socio-economic groups to discriminate thirty-three basic speech sounds? (2) When presenting contrasting pairs of speech sounds, does the use of known or nonsense words make a difference? The investigators presented thirty-three basic speech sounds in known words for the experimental group ADT1, and in nonsense words for the other experimental group ADT2. The training period lasted five weeks. Pre-tests and posttests using the Harrison-Stroud Reading Test and the Wepman Auditory Discrimination Test were administered to both control and experimental groups. Results of the study showed that the auditory discrimination program helped the subjects in the experimental group to discriminate more accurately. Both presentation of nonsense words and known words seemed to have equal effects on the experimental group. The findings suggested that when children from a low socio-economic environment come to school, they would profit from training in auditory discrimination.

Another study which investigated the factor of socio-economic status

as it relates to performance on auditory and visual discrimination tasks was that of Mortenson (1967:547-548). A stratified random sample of 1500 beginning grade one pupils was selected from upper, middle and lower socio-economic levels. Three auditory discrimination tests, which included discrimination of beginning sounds, vowel sounds and ending sounds of words, were administered to the subjects. Findings of the study showed that the higher the socio-economic status of the beginning grade one child, the higher was the performance on the auditory and visual discrimination tasks.

One of the more recent studies which investigated the relationship between socio-economic status and auditory discrimination was that of Fast (1968). She compared the auditory discrimination of selected speech sounds of grade one pupils in low socio-economic areas with that of grade one pupils in other-than-low socio-economic areas. The study was conducted in an urban centre in which there were few extremely low or high socio-economic groups. She, therefore, classified the socio-economic status of her subjects into two categories: (1) low socio-economic status (L.S.E.S.) and (2) other-than-low socio-economic status (O.S.E.S.). The randomly selected test sample of 120 grade one subjects was drawn from four schools in low socio-economic areas and from four schools in other socio-economic areas. The Fast-Cosens Auditory Discrimination Test was administered, individually, to determine the auditory discrimination ability of the pupils. A comparison of the mean scores on the auditory discrimination test indicated that the O.S.E.S. group performed significantly higher than the L.S.E.S. group. On the basis of her findings, Fast (1967:137) concluded that socio-economic status plays a significant role in the ability of grade one pupils to discriminate auditorily.

Summary

This section has reviewed literature related to studies of auditory discrimination and the factor of socio-economic status. There appears to be a significant relationship between language development and socio-economic status, and, as such, influences the auditory discrimination ability of young children.

IV. SEX DIFFERENCES AND AUDITORY DISCRIMINATION

Hall (1963:391-396) has stated that the ratio of boys, whose progress is slow through the elementary school grades, to girls experiencing the same difficulty is three to one. A comprehensive review of research studies by Cardon (1968:426-433) also indicated significant differences favoring girls in comparing the academic achievement, and especially reading achievement, of boys and girls in the elementary grades. Substantial differences in language ability between boys and girls were suggested as a probable source of reading disability. A similar viewpoint was expressed twenty years ago by Schonell (1948:121) who stated that because of the marked relationship between reading and school work in general, failure to achieve in elementary school could very well suggest disability in reading. Research has reported significant sex differences favoring the girls in reading achievement (Wyatt, 1966; Gates, 1961).

Among the factors which influence success in learning to read is that of auditory discrimination. That girls are more mature than boys in readiness for reading at the beginning of grade one was indicated in a study by Dykstra (1962:134). On the seven measures of auditory discrimination used in the study, girls were significantly superior in three while

the boys failed to hold an advantage in any at that time. Each of the auditory discrimination measures which demonstrated significant differences in favor of girls was highly correlated with reading achievement at the end of grade one. As a result of his investigation, Dykstra (1962:182) concluded that girls are significantly superior to boys in the auditory discrimination skills measured.

Reid (1962) stated that girls begin school with an auditory advantage and seem to make more use of auditory ability in learning to read. However, she noted that boys appeared to have reached a similar level as girls in some auditory skills by the end of the first year.

Beginning first-grade girls performed significantly better than boys across all socio-economic levels on the pre-reading auditory discrimination tasks in a study by Mortenson (1967:548). The auditory discrimination tasks included discrimination of initial sounds, vowel sounds and ending sounds of words. The study involved 1500 subjects who were selected according to sex and socio-economic status.

However, not all research, which has investigated auditory discrimination performance has shown girls to be superior to boys. Clark and Richards (1966:261), found no relationship between sex and ability to auditorially discriminate in a study of auditory discrimination among economically disadvantaged and nondisadvantaged preschool children.

Boys were found to be slightly superior to girls on the auditory discrimination of all sound types and on total auditory discrimination scores in an investigation by Cosens (1968:126). However, the differences were significant only on like word-pairs.

In a study of 120 grade one pupils in low and other-than-low socio-economic areas, Fast (1968:123) found no significant correlation between

sex and auditory discrimination.

Poling (1968) who conducted a two-year longitudinal study of auditory discrimination with beginning grade one pupils, hypothesized that boys and girls discriminate auditorially equally well. She found no significant differences between the auditory discrimination test scores for boys and girls. However, the boys' scores were higher than those of the girls.

Summary

While some studies have found a significant positive correlation between auditory discrimination and sex, others have not. It appears impossible to draw any definite conclusions as to the effect of sex on auditory discrimination performance. Therefore, sex will be controlled in this study.

V. INTELLIGENCE AND AUDITORY DISCRIMINATION

Research findings have been contradictory as to whether there is a significant positive correlation between intelligence and auditory discrimination.

Poling (1968:19) has pointed out that earlier studies were controversial because they did not investigate the influence of intelligence on the findings in the area of auditory discrimination. However, later ones have explored the relationship by securing findings both with and without intelligence statistically controlled.

In one of the earlier studies, Hall (1938:131) found a significant positive coefficient of correlation between auditory discrimination and memory span, and, both were correlated with intelligence.

Investigating the relationship of auditory discrimination to silent reading abilities, Wheeler and Wheeler (1954:108) found a correlation ranging from .38 to .46 between auditory discrimination and intelligence which they described as indicating "the possibility of a substantial relationship."

Wepman (1960:321) found a low positive correlation of .32 between auditory discrimination and intelligence. He suggested that more intelligent children seem to do somewhat better, generally, in auditory discrimination because attention to the task is necessary for discrimination to function at its best. A child with high intelligence attends to his task better and consequently his performance on the test is therefore better. He stated that in his study, the low correlation of +.32 indicated the comparative independence of auditory discrimination from intelligence.

A study by Christine and Christine (1964:98) was designed to determine whether poor auditory discrimination is basic to both poor articulation and reading retardation in grades one, two and three children. Findings indicated only a slight relationship between intelligence and auditory discrimination, as measured by the <u>Wepman Auditory Discrimination Test</u>. The coefficient of correlation was +.32.

Similar findings were reported in a study by Dykstra (1966:20). He correlated seven auditory discrimination measures, intelligence quotients as measured by the <u>Lorge-Thorndike Intelligence Test</u> and chronological age with two aspects of reading achievement in an investigation of auditory discrimination abilities and beginning reading achievement. Findings revealed that intelligence and five of the seven auditory discrimination tasks were significantly positively related to the <u>Gates Word Recognition</u> and <u>Gates Paragraph Reading Test</u> at the end of grade one.

Among those variables significantly related to reading ability, the <u>Lorge-Thorndike Intelligence Test</u> was consistently one of the best predictors. Intelligence by itself accounted for 21 per cent of the variability associated with word recognition. However, intercorrelations among the independent variables were consistently low, almost always below +.40. The seven auditory discrimination measures were related to intelligence to only a moderate degree.

Results of a study by La Pray and Ross (1967:530-532) indicated that children who performed poorly on auditory discrimination tasks, tended to do poorly in the basic reading skills. They also found low correlations between scores on the auditory tests and the intelligence test. The investigators suggested that auditory discrimination and intelligence are two different facets of a complex process.

Not all research studies have reported low correlations between intelligence and auditory discrimination however. A two-year longitudinal study by Thompson (1963:376-378) revealed different results. She conducted an investigation to determine the relationship of auditory discrimination and intelligence scores to success in primary-grade reading. She also attempted to determine whether children made significant improvement in auditory discrimination ability while attending grades one and two. In her study, auditory discrimination and intelligence were highly correlated with success in reading. From the high positive intercorrelation of the factors of intelligence and auditory discrimination, she concluded that adequacy in one trait is frequently accompanied by adequacy in the other at the beginning of the first year in school.

In a later study, Mortenson (1967:547-548) investigated the auditory discrimination ability of 1500 children selected by means of a stratified

random sample. Findings indicated that the higher the socio-economic status of the beginning grade one child, the higher the performance on auditory tasks and on the intelligence test. Intelligence was measured using the California Short-Form Test of Mental Maturity, Level 1. When intelligence was held constant, the higher socio-economic child performed significantly better on all of the auditory discrimination tasks with the exception of auditory discrimination of vowels.

Fast (1968:127) similarly investigated the auditory discrimination ability of 120 grade one subjects from two socio-economic levels. She found that intelligence and auditory discrimination correlated significantly for the total test sample at the .01 level of confidence.

The relationship of auditory discrimination to reading achievement and to intelligence were tested in a recent longitudinal study by Poling (1968:77). She hypothesized that pupils with good auditory discrimination would manifest intellectual ability superior to that of pupils with poor auditory discrimination. The Thurstone Test of Primary Mental Abilities was administered to all subjects in grade one during the first month of school. This test yielded an intelligence quotient, a mental age, and five particular scores each purported to measure a different aspect of intelligence. These five particular aspects, called primary mental abilities were as follows: verbal meaning; perceptual speed; quantitative, motor and spatial abilities. Findings indicated that there was limited support for her major hypothesis that pupils with good auditory discrimination will manifest intellectual ability superior to that of pupils with poor auditory discrimination. However, Poling (1968) stated that one can tentatively and partially accept the hypothesis upon the basis of distinctive findings with respect to the primary mental abilities, particularly

perceptual ability.

Summary

It would seem, as Dykstra (1966:20) has pointed out, that intelligence is one of the best predictors in reading achievement. Although it is generally agreed that there is a positive relationship between intelligence and auditory discrimination, the extent of the relationship varies with each research study. Intelligence, along with socio-economic status, chronological age and sex, has been included as an independent variable in the present study.

VI. CHRONOLOGICAL AGE AND AUDITORY DISCRIMINATION

Christine and Christine (1964:98) have stated that "the development of auditory discrimination appears to be a maturational process; therefore, children develop auditory discrimination skills at different ages." Those researchers who have postulated that auditory discrimination is developmental, would support the view expressed above (Kennedy, 1942; Henry, 1947; Wepman, 1960; Thompson, 1963).

Myklebust (1960:19) has suggested that full maturity of auditory functioning does not occur until approximately seven years of age.

To perceive and remember word sounds accurately requires an attention span and an accuracy of hearing beyond the capacity of many children at the time they enter school (Vernon, 1957:62). It has also been suggested that some children do not seem to develop the capacity to discriminate among similar sounds until they are eight years old, regardless of mental age (Goins, 1959:11).

Wepman (1960:330-331) conducted a study in which he investigated

grades one and two children's ability to make auditory discriminations between selected speech sounds in minimal word-pairs. His findings indicated a decreasing number of children with poor auditory discrimination as age increased. Similar studies, with grades one and two pupils, by Thompson (1963) and Poling (1968) revealed findings substantiating those of Wepman (1960).

Although the chronological range was automatically limited to approximately twelve months by the selection of grade one children, Poling (1968:77) stated that the extremely rapid maturation typical of this age group necessitated matching pupils within one or two months in order to minimize the possible influence of chronological age on the experimental variable.

Dykstra (1966:16), however, stated that age did not seem to be a significant factor in auditory discrimination ability as it related to reading achievement. Furthermore, it has been suggested by Carhart (1947:249) that many children by the age of three have learned to make the auditory discriminations which the world requires of the average adult.

Findings with respect to growth of auditory discrimination are inconclusive but they suggest the possibility of early maturation followed by less keen auditory discrimination at upper elementary and high school levels (Poling, 1968:41).

<u>Summary</u>

Research has yielded contradictory findings in assessing the relationship between chronological age and auditory discrimination. The investigator has, therefore, considered chronological age as an independent variable in the present study.

VII. DEVELOPMENT OF AUDITORY DISCRIMINATION

Various research studies have investigated the ability of children to make auditory discriminations among speech sounds. As a result of their findings, several researchers have postulated that auditory discrimination is developmental.

Mussen (1963:13-15) states that all the characteristics and abilities that a person acquires, and all developmental changes result from two basic processes, namely, maturation and learning. Since the two processes almost always interact, it is difficult to separate their effects. Various developmental psychologists interpret the terms maturation and learning differently. However, there is a common core of accepted meaning. All definitions of maturation stress organic processes or structural changes occurring within an individual's experiences or practice. Learning, on the other hand, generally refers to changes in behaviour or performance as a consequence of experiences. Within this framework, the ability to make auditory discriminations among speech sounds would then be attributable to both maturation and learning.

Therefore, development may be regarded as the changing end-product resulting from the interaction of maturational and learning factors. Thus, there is an implication that development represents a stage which has been achieved at any particular point of time in the maturation process. Changes may be thought of as occurring because of the complex interaction of the forces of nature and nurture. As this relates to auditory discrimination, the development of auditory discrimination of children would be the result of maturation and learning, and, the pattern might be discernible at the different grade levels.

From the data obtained in a study which investigated the auditory

discrimination, articulation, intelligence and reading achievement of 156 grades one and two pupils, Wepman (1960:326) developed the following auditory discrimination theory:

1. There is evidence that the more nearly alike two phonemes are in phonetic structure, the more likely they are to be misinterpreted.

2. Individuals differ in their ability to discriminate sounds.

3. The ability to discriminate frequently matures as late as the child's eighth year.

4. There is a strong positive relation between slow development of auditory discrimination and inaccurate pronunciation.

5. There is a positive relation between poor discrimination and poor reading.

6. While poor discrimination may be at the root of both speech and reading difficulties, it often affects only reading or speaking.

7. There is little if any relation between the development of auditory discrimination and intelligence as measured by most intelligence tests (Wepman, 1960:326).

Wepman believes that audition is not a function in which all parts are ready to work with equal facility. He states that audition develops in at least three levels with sequential development within each level. Acuity, the ability of the ear to collect sounds from the environment and transmit them to the nervous system, appears first. Understanding, the ability of the central nervous system to extract and interpret meaning develops next. Finally, discrimination and retention, the abilities that permit the individual to monitor his speech or to make accurate phonic comparisons, appear.

Wepman (1960:332) emphasizes the importance of assessing the individual needs of children when they enter school. He believes it is necessary to individualize instruction, at least to the point of grouping auditory and visual learners, in the beginning stages of reading. In this way it is possible to maximize children's better-developed modalities

until such a time as their developmental processes come into balance through maturation or training.

Very early in life, children react only to gross differences in sound. As they mature, they are able to make finer distinctions between sounds of auditory patterns until eventually they can identify and distinguish each sound of the language. Wepman (1960:328) contends that when children can distinguish between sounds and have models of good speech, they produce good speech, unless they have structural defects. He points out that such defects account for only 20 per cent of all articulatory defects of childhood.

Research has indicated that sound acquisition in the speech of children is progressive in nature. Templin (1957:53) reported her findings along with those of Poole (1934) and Wellman (1937) in an investigation of articulation of speech sounds of words. The subjects in the studies ranged from age three through eight. The ages at which the various speech sounds are mastered, as reported by Templin (1957) are summarized in Table I.

Wepman (1960:329) contends that as auditory discrimination develops, more speech sounds become available to the speaker. It would seem then that this ability to discriminate sounds may continue to mature until the eighth year of a child's life.

Among the studies which have found that there is a significant relationship between articulation and auditory discrimination is that of Schiefelbusch and Lindsey (1958:153-159). According to their findings, grades one and two children who had articulatory disorders also had faulty auditory discrimination. A longitudinal study of these same subjects revealed that the children who had articulation problems tended to mature

TABLE I

AGE AT WHICH SPEECH SOUNDS ARE MASTERED BY STUDENTS
AS REPORTED BY TEMPLIN, WELLMAN, AND POOLE
(Templin, 1957:53)

Speech Sound	Study Source		
	Templin	Wellman	Poole
m	3	3	3.5
n	3	3	4.5
ŋ	3	-	4.5
p	3	4	3.5
f	3	3	5.5
h	3	3	3.5
w	3	3	3.5
y	3.5	4	4.5
k	4	4	4.5
b	4	3	3.5
d	4	5	4.5
g	4	4	4.5
r	4	5	7.5
s̀	4.5	5	7.5
š	4.5	5	7.5
č	4.5	5	-
t	6	5	4.5
θ	6	-	7.5
v	6	5	6.5
l	6	4	6.5
ð	7	-	6.5
z	7	5	7.5
ž	7	-	6.5
ǰ	7	6	-

more slowly in auditory discrimination ability than the children who did not have articulation disorders.

The relationship between children's correct pronunciation and discrimination of speech sounds was further supported in an investigation by Christine and Christine (1964:97-99). Using a test sample of grades one, two and three subjects, they concluded that poor auditory discrimination is a significant factor in reading retardation and articulatory problems among primary children.

Olmsted (1966:531) who stated that "learning as measured by correct pronunciation is a function of ease of perception of sound", predicted that the more discriminable sounds are learned earlier than the less discriminable ones. Therefore, if the maturation of auditory discrimination is basic to the acquisition of speech sounds, and, if the acquisition of speech sounds is progressive or developmental in nature, then perhaps auditory discrimination is also a developmental process. This view was supported by Fast (1968:160) who found that those sounds which are mastered latest according to Templin (1957:53) are also those sounds which cause the most difficulty in discrimination for grade one pupils.

Evidence of sequential development in auditory abilities has been reported by Kennedy (1942:238-251). She investigated the auditory acuity and discrimination of 433 subjects between the ages of six and twenty-three. Findings of her cross-sectional study showed that there were significant differences in the mean auditory acuity of children between the ages of six and fifteen years. The differences were most evident between the six-and seven-year old levels, the seven and eight-year-old levels, and between the twelve and fifteen-year-old levels. Among other things, Kennedy (1942) noted that high-frequency loss of hearing tended

to affect the discrimination of consonants which in English carry the intelligibility of the language. Newby (1964:104) has identified the higher frequency consonants as the following voiceless ones: p, k, s, t, f, sh, ch and th. In conclusion, Kennedy (1942) stated that it seemed quite evident that there was a developmental change in hearing, both in acuity and discrimination.

Another extensive study of auditory acuity which substantiated Kennedy's (1942) findings was that of Henry (1947:3-63). Using 287 children from grades one through six, she summed the scores for low-tone, medium-tone and high-frequency hearing loss. Her findings indicated that high-frequency loss was the greatest. Because of the importance of the consonant sounds, and the fact that they occur in the higher sound ranges, the relationship of high-frequency hearing loss to reading is readily explained.

In an attempt to investigate the auditory acuity of pre-school children, Myklebust (1954:263-269) initiated a research study using a sample of sixty-one subjects between the ages of three and five-and-a-half years. After some experimentation, it was found necessary to modify the pure tone audiometric test for seventeen of the subjects. The procedure consisted of engaging the subject in a game-like listening situation. Findings of the study indicated that there was substantial improvement in responses between four-and-one-half and five years, and again between five and five-and-one-half years. Myklebust (1954:266) summarized by stating that the average threshold decreases toward the zero decibel line as the age increases.

As a result of the paucity of research in the field of audiology following her initial investigation, Kennedy (1957:756-761) conducted a

follow-up study to that of Myklebust (1954) which was concerned with the maturation of hearing. Her sample consisted of 433 subjects ranging in age from six years to a young adult level at the Laboratory School, University of Chicago. She was interested in finding any variations which might occur in auditory acuity by controlling sex and laterality differences as well as those related to age. Myklebust's (1960:327) findings which indicated that hearing is developmental were supported by Kennedy's (1957:860) study. She found a significant difference between the six and eight-year old groups, and to a lesser extent between the eight and fifteen-year old groups. The six-year old child heard the middle range of frequencies, 1000 to 4000 cycles per second, more acutely than either the lower or higher frequencies. The child's acuity increased throughout the range tested until about the age of fifteen. The greatest increases occurred at the low and high frequencies, especially in the latter. Kennedy (1957) concluded that hearing is a maturational process without significant sex or laterality differences. She stated that maturation did not follow a "straight line pattern but rather one of spurts and plateaus."

A child may be able to hear and to understand what is being said and yet be unable to discriminate the sounds that make up the words. As was stated previously, it is believed that there is a sequential development in attaining the overall ability to use auditory signals. Consequently, researchers, who have conducted studies similar to that of Wepman (1960:331) have postulated that auditory discrimination is developmental.

Thompson (1963:376-368) whose investigation was mentioned earlier, attempted in a longitudinal study to determine whether children made significant improvement in auditory discrimination ability while attending grades one and two. Three tests were administered to the 105 subjects at

[illegible]

the beginning of grade one and again at the end of grade two. Results indicated that the subjects generally improved in ability to auditorially discriminate over the two year period. However, 20 per cent of the grade two children still had inaccurate auditory discriminative ability. The decreasing number of pupils who had discriminatory problems by the end of grade two were interpreted as being indicative of the developmental nature of auditory discrimination.

Poling (1968) whose study attempted to ascertain the relationship of auditory discrimination to reading achievement, also attempted to measure the amount of improvement in auditory discrimination which occurred during grades one and two for those subjects whose scores were unsatisfactory at the beginning of the first grade. The Wepman Auditory Discrimination Test was individually administered to 153 grade one subjects shortly after the beginning of the school term. Twenty-two poor discriminators from the lower quartile on the auditory discrimination test were paired with twenty-two good discriminators, from the upper quartile, on the variable of sex, intelligence quotient, mental and chronological age. The poor discriminators, who by the end of grade one had achieved adequate auditory discrimination scores, and their matched good discriminators were designated as the group of great-change. There was no significant difference between the formerly poor discriminators and their pair mates at the end of grade one. The group of poor discriminators who did not achieve adequate auditory discrimination scores at the end of grade one were designated as the group of little-change. At the end of grade two, the discrimination test was again administered to the group of little-change to determine the amount of improvement during the second year. There was no significant difference between the scores

of the little-change group and their matched discriminators, indicating that, as a group, the poor discriminators had also become good discriminators. Poling (1968) therefore concluded that for many children, adequacy in auditory discrimination is not acquired until the end of grade two. The findings of this study support those of Thompson (1963) in her postulation that auditory discrimination is developmental. It would seem, as Myklebust (1960:19) suggests, that "full maturity of auditory functioning does not occur until approximately seven years."

Myklebust (1960:18) who states that, in the study of hearing, it is "necessary to separate startle, or involuntary reactions, from listening, or voluntary behaviour", contends that listening behaviour must be acquired and is dependent on learning and maturation.

The importance of instruction in auditory discrimination was also pointed out by Poling (1968), who recommended training as early as kindergarten in learning to hear the fine differences in words. This view was supported by Deutsch, C. (1964:282) who emphasized that there is "an optimal time for training in auditory discrimination."

Although the maturational aspects of hearing have important implications for the development of auditory discrimination, studies have shown that training is also influential in improving auditory discriminative ability.

An experimental study by Cosens (1968) investigated the effect of training in auditory discrimination on the reading achievement and the auditory discrimination of sixty grade one pupils. The sample consisted of those pupils, from four grade one classrooms, who scored below the 60th percentile on the Fast-Cosens Auditory Discrimination Test. The subjects were randomly assigned to the control and experimental groups.

The study involved a pretest-treatment-posttest comparison of subjects given a four week training program in auditory discrimination with those not given such treatment. Findings indicated that training in auditory discrimination at the end of grade one resulted in improved scores on total auditory discrimination. As a result of her study Cosens (1968:173) stated that

> discrimination of certain sound types appeared to yield to training more than discrimination of others. Teachers should therefore realize that auditory discrimination training may not increase the discriminability of all types of sounds.

Results of a similar study by Silvaroli and Wheelock (1966:247-251) revealed that a five-week training program helped grade one pupils to auditorially discriminate more effectively.

Betts (1957:129) suggested that auditory training should be initiated in the reading readiness period and should be extended into the reading program of children who are learning to read.

The importance attached to auditory discriminative ability as a readiness factor for beginning reading is evidenced by the emphasis placed upon training in this area in the pre-school programs for disadvantaged children (Muskowitz, 1963:219).

Upon the basis of findings in their study which investigated the effects of auditory and visual training, La Pray and Ross (1967:532) concluded that "children do not learn to listen without our help." It is essential that classroom teachers help children build auditory perception and listening skills. As has been stated,

> maturational readiness doesn't just happen: much of what is implied in the term is learned. It is the responsibility of education to provide experiences and activities for children that insure their personal involvement until a measurable degree of maturity is reached (Jones, 1964:111).

Summary

While research studies seem to indicate the need for training in auditory discrimination, they also seem to stress the importance of the developmental aspects of auditory discrimination in learning to read. As Myklebust (1960:18) states, "listening behaviour must be acquired and is dependent on learning and maturation."

CHAPTER III

THE EXPERIMENTAL DESIGN

This chapter consists of a description of the design of the present study. Research procedures including the sampling and data collection, the various instruments used, and the data analysis are outlined in three main sections.

I. THE SAMPLE

The Selection

The test population in this study consisted of all children attending kindergarten in Edmonton, and all children enrolled in grades one, two and three in the Edmonton Public School System. The test sample consisted of kindergarten, grades one, two and three pupils randomly selected from two schools and two kindergartens designated by officials in consultation with the investigator. One school and one kindergarten were from an area designated as serving families of high socio-economic status and one school and one kindergarten were from an area designated as serving families of low socio-economic status. Twenty boys and twenty girls were randomly selected at each grade level, thus yielding a total test sample of 160 subjects. Although kindergartens are not, generally, an integral part of the educational system in the province of Alberta, the investigator was able to incorporate kindergarten subjects into the design of the present study. The kindergarten in the low socio-economic area was one of the experimental kindergartens established by the Edmonton Public School System in 1968. The designated high socio-economic kindergarten was a privately operated kindergarten in the city of Edmonton.

The mean chronological age of the pupils in each of the four

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

grades is shown in Table II.

TABLE II

MEAN CHRONOLOGICAL AGE OF THE TEST SAMPLE BY GRADES

Grade	No. of Subjects	Mean Chronological Age in Months	Standard Deviation
Kindergarten	40	72.07	3.47
Grade One	40	83.44	3.86
Grade Two	40	95.55	4.25
Grade Three	40	108.40	4.70
Total Sample	160		

The chronological ages of the subjects in the test sample were taken from the cumulative records on file in the school.

Due to the fact that the present study was investigating the ability of children to make auditory discriminations between speech sounds, an auditory screening test, by means of a Maico Audiometer, was individually administered to each subject. Any pupil with inadequate auditory acuity was eliminated from the study and replaced by another randomly selected subject.

Socio-Economic Status

In order to obtain a socio-economic rating for each subject, a modified version of Elley's (1961) revision of the Gough Home Index Scale, with the questions reworded so that they could be answered by the parents, was sent to the parents of all pupils in the test sample.

On the assumption that socio-economic status is measured best by a combination of indices, Gough (1949:52-56) developed the Home Index

Scale. Elley (1961:105) modified Gough's scale to make it more applicable to Alberta. The present study used a slightly modified version of the scale used by Elley. The scale or questionnaire used in this study appears in Appendix A. The changes (inclusion of a stereo, colored television, and magazine subscriptions) were thought to be necessary to keep abreast of changes in the standard of living. Interestingly enough, findings relative to the number of colored television sets in the homes of the subjects were a direct reversal to expectations. It would seem that the high socio-economic group do not attach any great importance to possessing colored television as indicated by the absence of same in their homes. Time payments or credit buying now make it possible to purchase luxury items which previously many families would not have been able to afford. This could possibly explain the greater number of colored television sets in the homes of the low socio-economic families.

The investigator found many parents in one socio-economic area to be extremely sensitive about providing the information requested in the questionnaire. In view of the reaction that many of the questions were of an extremely private nature and had no bearing on the proposed study, the investigator would have strong reservations about using this type of an instrument in a future study.

A covering letter accompanied the questionnaire (See Appendix A). Each subject was assigned a code number by the investigator and this code number appeared at the top of the questionnaire. This procedure was utilized to avoid making it necessary for the parents to sign the questionnaire.

The questionnaires were scored according to the directions for the Gough Home Index Scale. Each subject was also assigned a rating accor-

ding to Blishen's (1968) Socio-Economic Index for Occupations. The father's and mother's occupation were obtained from the cumulative record cards. The mother's occupation was used only where she was the main support of the family.

The total socio-economic status (S.E.S.) for each pupil was calculated by combining for each child a score based on the occupation of the father according to Blishen's (1968) Socio-Economic Index for Occupations and the score on the revised home index questionnaire.

Whereas the 1958 Blishen Scale, based on the 1951 census, divided 343 occupations into seven classes on the basis of mean income and mean education, the Socio-Economic Index for Occupations, based on the 1961 census data followed the procedure of Pineo-Porter, as reported by Blishen (1968:741-753), who attempted to scale occupations in Canada. Using their approximations for 88 occupations, prestige scaled scores were assigned to the occupational titles. A regression equation, which had as the dependent variable the eighty-eight Pineo-Porter scores which overlapped the 1961 census list, and had as the independent variables the corresponding income and educational indices, was constructed. The regression weights in percentages were then applied to 320 occupations in Canada, and a socio-economic index was derived. The rank correlation between the new socio-economic index and the 1951 occupational class scale is .96.

The mean S.E.S. scores according to high and low socio-economic levels by grades are shown in Table III. The revised Home Index Scale sought to obtain additional information relative to the home situation of the subjects in this study. As indicated in Table III, the home environment of the low socio-economic groups varied only slightly at the

TABLE III

MEAN S.E.S. SCORES OF TEST SAMPLE BY SOCIO-ECONOMIC STATUS AND GRADE

Grade and S.E.S.	No. of Subjects	Home Index Score	Blishen Rating	Total S.E.S. Score	Range of S.E.S. Scores	Difference in Range of S.E.S. Scores
L.S.E.S. Kindergarten	20	8.25	32.12	40.27	31.93-47.90	15.97
H.S.E.S. Kindergarten	20	14.30	65.49	79.79	68.82-91.57	22.75
L.S.E.S. Grade One	20	9.50	34.96	44.45	31.18-60.96	29.78
H.S.E.S. Grade One	20	17.15	67.93	84.43	72.17-96.59	24.42
L.S.E.S. Grade Two	20	8.50	34.85	42.85	30.61-62.85	32.24
H.S.E.S. Grade Two	20	17.95	69.16	87.11	70.07-96.57	26.50
L.S.E.S. Grade Three	20	8.50	33.94	42.44	29.31-58.98	29.67
H.S.E.S. Grade Three	20	17.20	64.18	81.38	67.68-93.16	25.48
Total Test Sample	160	12.67	50.33	62.84		

four grade levels. The mean S.E.S. scores of the low groups were well below the 12.67 mean of the test sample on the home index questionnaire. On the other hand, the mean scores of the high socio-economic groups on the same home index were well above the 12.67 mean, indicating that the pupils in these groups were from homes that provided children with a variety of experiences which are considered significant factors in determining social status rating. The range in the total S.E.S. scores for all groups is shown in Table III. The least range occurred in the low S.E.S. kindergarten group indicating that the pupils were essentially a comparatively low as well as a homogeneous group relative to socio-economic rating. The greatest range occurred in the low S.E.S. grade two group where the scores ranged from 30.61 to 62.85. The mean score of 42.85 indicates that the majority of total S.E.S. scores were at the lower end of the range, while, in fact, only two scores were markedly higher than the rest of the group.

Figure 1 illustrates the mean socio-economic scores for the high and low groups at each grade level when the scores on the Home Index Scale are combined with the ratings on the Blishen (1968) Socio-Economic Index for Occupations. As can be seen in Figure 1, the subjects in this study were from two extreme socio-economic levels.

II. TESTING INSTRUMENTS

A description of the auditory tests and the intelligence test used in this study will be given in this section.

Auditory Tests

Auditory Acuity. Each of the 160 subjects in the test sample

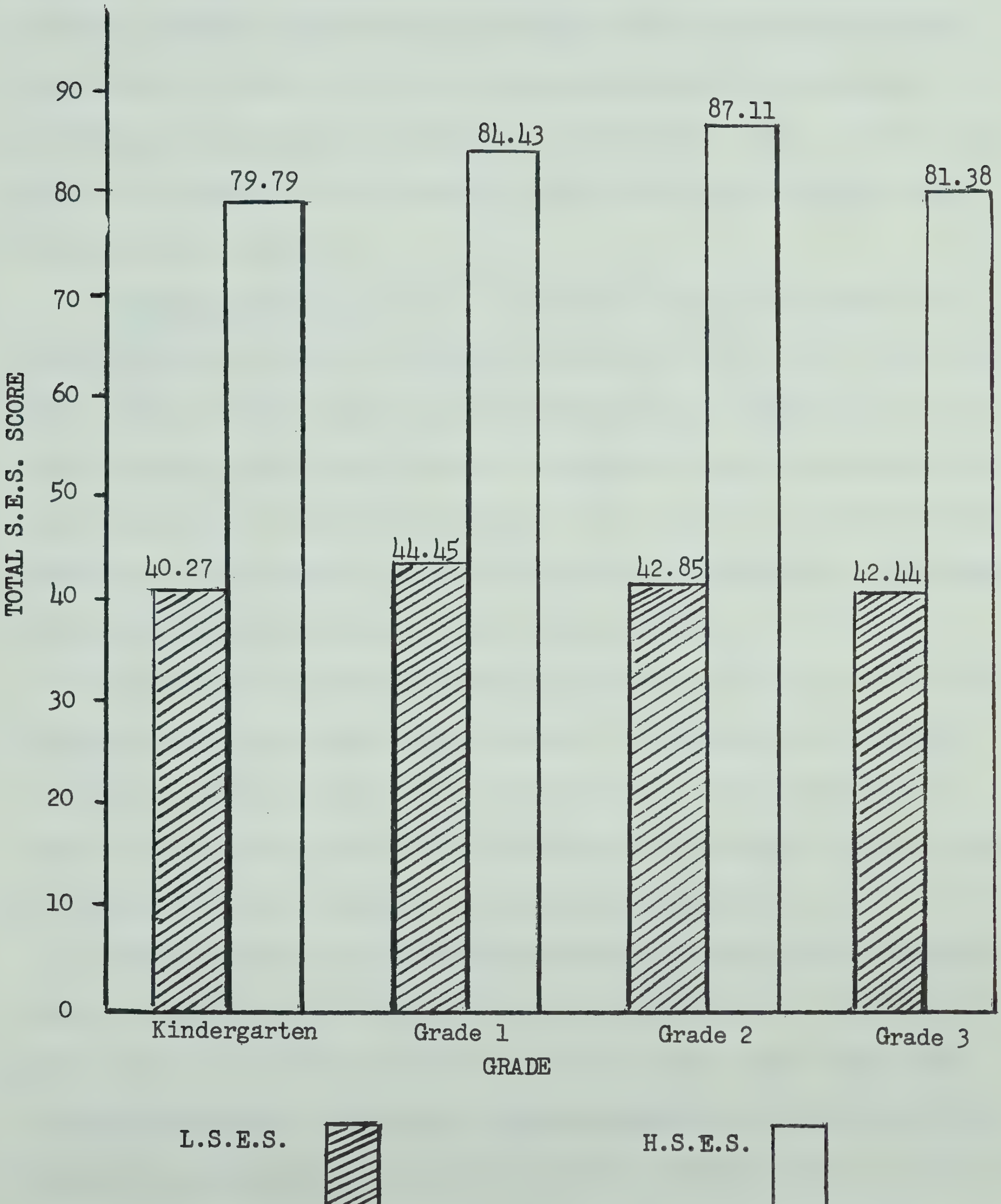

FIGURE 1

MEAN S.E.S. SCORE BY GRADES

was individually administered an audiometric test by the researcher and an assistant in the month of May. As Newby (1964:194) stated, it may be necessary to spend more than one session when attempting to achieve pure-tone threshold measurements on young children. The investigator found this to be true. To rule out the possibility of erroneously excluding a young subject on the basis of deficient acuity, a retest was given if the examiner entertained any doubts about the validity of the audiometric test results.

A Maico Audiometer, which is a portable unit equipped with ear phones was used to test the subjects' hearing at the 250, 500, 1000, 2000, 3000, 4000 and 8000 frequencies. The audiometer is constructed so zero decibel hearing loss is the intensity required to reach the threshold of the average ear 50 percent of the time. The intensity is controlled and graduated in five decibel steps. Hearing loss is expressed as the number of decibels exceeding the zero point (Newby:1964,65).

The subject was seated so that he could not see the panel of the audiometer which the investigator operated. Following a more careful explanation of the procedure to be followed, the subject was given sufficient practice to ensure that the pupil was attending to the stimulus and could indicate his response in the manner requested.

The intensity at the 1000 frequency was decreased until the child could no longer hear the sound and then increased until he could hear it again. The same procedure was used at the 500, 250, 2000, 3000, 4000 and 8000 frequencies. The subject indicated whether or not he could hear the sound by raising or lowering his fingers. Care was taken to alter the intervals between tonal presentations so that the child did not learn to respond to a rhythmic pattern. The results for each ear were recorded on

an individual audiogram card provided by the Maico company.

Pauls and Hardy (1953:538-539) conducted an investigation of hearing impairment in preschool-age children. They suggested a classification which could be used as a general guide in assessing the severity of hearing losses of young children. Table IV sets forth the recommended classification.

TABLE IV

HEARING IMPAIRMENT IN PRESCHOOL CHILDREN

Extent of Loss in Decibels	Degree of Loss
20 - 40 db	Mild
40 - 60 db	Moderate
60 - 75 db	Severe
75 - 100 db	Profound

It has been suggested that losses of "twenty decibels at two or more frequencies or thirty decibels or greater at any single frequency" indicate deficient hearing (Newby, 1964:223). Due to the impossibility of being able to administer the audiometric testing in a sound-proof room, standards were set by the investigator so that only those subjects who had losses of twenty-five decibels at two or more frequencies or thirty decibels or greater at any single frequency were eliminated from the study. This would concur with the International Standards Organization standards as reported by Broderick and Kranz (1965:570-571).

In the present study, twenty pupils were eliminated due to inadequate auditory acuity. The distribution was as follows: kinder-

[illegible]

garten, two boys and three girls; grade one, two boys and one girl; grade two, two boys and four girls; grade three, six boys. These children, generally, experienced more difficulty in hearing at the 250 and 500 lower frequencies, and, the 4000 and 8000 higher frequencies. These findings indicate the need for audiometric testing before or at the time children enter grade one. A similar recommendation has been made by previous researchers working in the field of auditory perception (Reid, 1964; Cosens, 1968).

Auditory Discrimination. Auditory discrimination was measured by the *Fast-Cosens Auditory Discrimination Test*. This is a non-standardized test which was constructed by two researchers at the University of Alberta in 1968. The test was administered to all subjects by the investigator and two assistants during the months of May and June. By using dividers it was possible to individually test three subjects at a time. The test was administered in two twenty minute sessions with a five minute break between sessions. Due to the factors of short attention span and fatigue, the tape presentation was stopped momentarily at the end of every thirty-five items for the kindergarten subjects.

In the present study which used the *Fast-Cosens Auditory Discrimination Test* with 160 subjects from kindergarten, grades one, two and three, the KR-20 reliability index was .94.

Since the criterion variable in the present study was auditory discrimination and the measuring instrument used was the recently devised *Fast-Cosens Auditory Discrimination Test*, information related to the theoretical background of the test seems necessary.

The Fast-Cosens Auditory Discrimination Test. The instrument was designed to test auditory recognition of minimal differences that exist

between the phonemes used in speech. Previous researchers have widely used the Wepman Auditory Discrimination Test for this purpose for many years. Fast (1968) and Cosens (1968) constructed a revised and lengthened word-pairs instrument which would perhaps more clearly discriminate between children with good and poor auditory discrimination.

The following definitions refer to terms which are used to describe the phonemic consonants in the Fast-Cosens Auditory Discrimination Test (Fast, 1968:46).

Stops: Stops are consonants in which the flow of air is stopped or obstructed when articulated. The stops include/p,t,k/ and /b,d,g/.

Fricatives: Fricatives are the "nine consonants which are produced by an obstruction of the air stream causing audible friction". These are: /f,v,θ,ð,s,z,š,ž,h/ (Stageberg, 1965:22).

θ as in "thin"   š as in "shun"

ð as in "then"   ž as in "azure"

Affricates: Affricates are a special type of stops. Here the closure of the stops is gradually released to permit a slight friction noise. The sounds /č/ and /ǰ/ as in "chill" and "Jill" respectively, are the two affricates.

Nasals. Nasals are the sounds which are produced by forcing air through the nasal cavity. The nasal sounds of English are: /n,/m,/ŋ/. For example: /ŋ/ as in "ring".

Lateral: Lateral is the /l/ sound, "made by placing the tongue on the alveolar ridge and vibrating the vocal cords as the air passes out on both sides of the tongue" (Stageberg, 1965:24).

Glides: Glides are sounds produced by a vibrating tongue position. They are: /r,y,w,/ and are all voiced sounds (Stageberg, 1965:24).

Voiced: Speech sounds produced while the vocal cords are vibrating are said to be voiced.

Voiceless: Speech sounds produced while the vocal cords do not vibrate are said to be voiceless.

Bilabial: Bilabial is a speech sound produced by closing the two lips, with or without the addition of voicing. Bilabial sounds are: /p,/b,/m/.

Labiodental: This is a speech sound produced with the lower lip against or touching the upper teeth. Labiodental sounds are: /f,/v/.

Interdental: This speech sound involves articulation of the tongue between the upper and lower teeth. The interdental sounds are: /θ,/ð/.

Alveolar: This is a speech sound produced with the position of the "tongue permitting a small stream of air to hiss over its surface at the alveolar ridge" (Stageberg, 1965:23). The alveolar ridge is the teethridge (Pike, 1947:233). They are /t,/d,/s,/z,/n,/l,/r/.

Alveopalatal: The alveopalatal is a production of speech sound with "the point of articulation near the teethridge and front part of hard palate" (Pike, 1947:233). They are: /š,/ž,/č,/ǰ,/y/.

Velar: This is a speech sound produced with the point of articulation at the soft palate in order to close the nasal cavity. The sounds are: /k,/g,/ŋ,/w/ (Fast, 1968:46).

The choice of items was based on the research of Miller and Nicely (1966), Templin (1957), and Miller (1951) as it relates to discrimination errors, articulation errors and frequency of phonemes in the English language.

Miller and Nicely (1966:170) found that nasality and voicing are the most discriminable features of speech sounds. Therefore it is relatively easy to discriminate between nasal and non-nasal sounds, and, between voiced and voiceless sounds. Consequently, voiced sounds were contrasted with voiced sounds, and, voiceless sounds were contrasted with voiceless sounds in the items on the Fast-Cosens Auditory Discrimination Test. Similarly, sound contrasts which required discriminating between nasal sounds, but not between nasal and non-nasal sounds were included in the word-pair items of the test.

Findings of Miller and Nicely (1966:166) also indicated that place of articulation is an important factor in the discrimination of speech sounds. They grouped the consonants according to three places of articulation in the mouth, namely, front, middle and back:

front /p/,/b/,/f/,/v/,/m/

middle /t/,/d/,/θ/,/s/,/ð/,/z,/n/

back /k/,/g/,/š/,/ž/

According to findings of the study, the distinction between the voiceless /f/ and the voiceless/θ/ and between the voiced /v/ and the voiced /ð/ are among the most difficult to hear.

Table V shows the twenty-four English consonant phonemes as classified according to place of articulation and sound type.

Miller (1951:86-88) in another study reported that 38 per cent of the phonemes are vowels and diphthongs and 62 per cent are consonants. Some consonants are rarely used while others are used extensively. "Only five different sounds make up more than 50 per cent of the final consonants" (Miller, 1951:87), four of these being /ng, z,v,r/.

Research of Templin (1957:53) indicated that final consonants were mastered later than initial consonants, and that affricates and fricatives are mastered later than stops. Therefore, in the Fast-Cosens Auditory Discrimination Test more comparisons of consonants in the final position, and, more comparisons among fricatives and affricates than among stops are included.

Table VI illustrates all the phoneme comparisons made in the Fast-Cosens Auditory Discrimination Test.

The Fast-Cosens Auditory Discrimination Test consists of 266 word-pairs which are presented on a tape recording. The latter ensures consistency of presentation. If the word-pairs are different, the pupil raises his hand, but if the word-pairs are the same he keeps his hand down.

The different word-pairs are minimal pairs, that is, there is only one phonemic change in the word. Of the 133 unlike word-pairs, sixty-six

TABLE V

ENGLISH CONSONANT PHONEMES*

Type of Sound		Bilabial	Labiodental	Interdental	Alveolar	Alveopalatal	Velar	Glottal
		Position of Articulators						
Stops	vl	p			t		k	
	vd	b			d		g	
Fricatives	vl		f	θ	s	š		
	vd		v	ð	z	ž		h
Affricates	vl					č		
	vd					ǰ		
Nasals		m			n		ŋ	
Lateral					l			
Glides					r	y	w	

*Stageberg, 1965:25

TABLE VI

ENGLISH CONSONANT PHONEMES COMPARED IN THE FAST-COSENS AUDITORY DISCRIMINATION TEST (Fast, 1968:57)

Type of Speech Sound		p	t	k	b	d	g	f	θ	s	š	v	ð	z	ž	č	ǰ	m	n	ŋ	l	r	y	w	Word Examples of Selected Speech Sounds
		Stops vl			Stops vd			Fricatives vl				Fricatives vd				Affr.		Nas.			L	Glides			
Stops vl	p		v <	<				> <	> <																
	t	v <		v <																					
	k	<	v <																						
Stops vd	b					<	<					> <	> <												
	d				<		<			<			<	<											
	g				<	<																			
Fricatives vl	f	> <							> <	> v <	> v <														
	θ	> <						> <		> v <	> v <														(thin)
	s					<		> v <	> v <		> v <						v <								
	š							> v <	> v <	> v <						> v <									(sure)
Fricatives vd	v				> <								> v <	> v <											
	ð				> <	<						> v <		> v <											(that)
	z					> <						> v <	> v <				> v <								
	ž																v								(azure)
Affricates	č										> v <														(chill)
	ǰ									v <					> v <	v									(Jill)
Nasals	m																			v <					
	n																			v <					
	ŋ																	v <	v <						(ring)
Lateral	l																					> v <		>	
Glides	r																				> v <			>	
	y																								
	w																				>	>			

Key: > initial consonant comparisons made

v medial consonant comparisons made

< final consonant comparisons made

items contain voiced phonemic comparisons and sixty-seven contain voiceless phonemic comparisons. Of the 133 unlike word-pair items, sixty-one consist of final sound comparisons, thirty-five of medial sound comparisons and thirty-nine of initial sound comparisons.

A copy of and directions for administering the Fast-Cosens Auditory Discrimination Test are included in Appendix B.

Intelligence

The choice of this test was partially governed by the availability of eight test levels which are all scaled to the Stanford-Binet Intelligence Scale, 1960 Revision, (Form L-M). At each level, the rate and scope of mental development are measured in terms of the following four factors: logical reasoning, numerical reasoning, verbal concepts and memory. Seven test units within these factors are grouped into two main sections, namely Language and Non-language. A separate mental age and intelligence quotient are obtained for each of these sections. In addition to this, the test also yields a total mental age and a total intelligence quotient. Copies of the California Short-Form Test of Mental Maturity, Level o and Level 1, are included in Appendix C.

As recommended by Buros (1965), Level 0 was used for all of the kindergarten subjects and Level 1 for all subjects in grades one, two and three.

The mean Language, Non-language and Total Intelligence Quotients by sex and grade are shown in Table VII.

Results of the California Short-Form Test of Mental Maturity indicated that the mean intelligence quotient for kindergarten group was highest and that of the grade three group was lowest when a comparison is made among the four grades. Total I.Q. scores of the subjects in the

TABLE VII

MEAN I.Q. SCORES OF THE TEST SAMPLE AS MEASURED BY THE CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

Grade and Sex	Language I.Q.	Non-Language I.Q.	Total I.Q.
Kindergarten			
Girls	109.5	111.3	111.45
Boys	111.2	119.55	117.25
Total			114.35
Grade One			
Girls	102.95	109.55	106.80
Boys	114.25	111.95	114.95
Total			110.77
Grade Two			
Girls	103.65	110.75	107.90
Boys	112.10	112.65	113.95
Total			110.92
Grade Three			
Girls	106.5	108.7	107.75
Boys	106.8	110.2	109.75
Total			108.75

[illegible]

test sample ranged from sixty-four to 145. Both the highest and lowest scores were made by kindergarten subjects. The boys I.Q. scores were higher than the girls at all four grade levels. The difference between the sexes as related to school achievement in the primary grades has often been attributed to the superior language development of girls at the time of school entrance. Girls, in the presence of the mother and within the home, more frequently engage in imitative play which usually involves a considerable amount of oral language. Boys, on the other hand, tend to engage in more physical, rigorous, outdoor play which necessitates a lesser degree of language usage. Therefore, it was of considerable interest that the boys at all grade levels in the present study scored higher than the girls on the Language section of the test. There was only a slight difference between the boys' and girls' Non-language I.Q's, favoring the boys.

A summary of the data relative to chronological age, socio-economic status, intelligence quotients, mental age by grade and sex is presented in Table VIII.

The difference between the mean mental ages of the boys and girls favored the boys at every grade level. The range of the Non-language M.A.'s between boys and girls was not as great as was the range in the Language M.A.'s. Relative to the latter, the differences were greatest in grades one and two, the differences being 12.95 and 11.05 months respectively. However by the end of grade three, the difference between boys and girls was only minimal, namely 1.15 months. The slight difference in S.E.S., as depicted by total S.E.S. scores, for boys and girls in each of the low and high socio-economic groups, together with equal opportunities of schooling over a period of three years, could be

TABLE VIII

MEAN CHRONOLOGICAL AGE, S.E.S., I.Q., AND MENTAL AGE OF TEST SAMPLE BY GRADE AND SEX

Grade and Sex	Chronological Age (months)	S.E.S. Score		Intelligence Quotient	Mental Age (months)	Mental Age (months)	
		Low S.E.S.	High S.E.S.			Lang.	Non-Lang.
Kindergarten							
Girls	72.05	39.86	78.90	111.45	79.20	77.75	79.05
Boys	72.10	40.67	80.69	117.25	83.15	79.20	84.35
Total	72.07	40.27	79.79	114.35	81.17	78.48	81.70
Grade One							
Girls	83.75	43.44	87.15	106.80	89.30	81.85	90.00
Boys	83.15	45.44	82.02	114.95	95.40	94.80	92.90
Total	83.45	44.45	84.58	110.77	92.35	88.30	91.45
Grade Two							
Girls	94.25	41.24	88.63	107.90	103.25	99.20	105.80
Boys	96.85	44.45	85.58	113.95	112.60	110.25	110.75
Total	98.05	42.85	87.11	110.92	107.93	104.72	108.27
Grade Three							
Girls	107.90	41.78	80.24	107.75	120.25	118.05	120.15
Boys	108.90	43.11	82.51	109.75	122.60	119.20	123.05
Total	108.40	42.44	81.38	108.75	121.43	118.62	121.60

influential factors in the resultant grade three findings.

III. ANALYSIS OF THE DATA

The subjects' responses on the Fast-Cosens Auditory Discrimination Test were recorded in IBM Answer Sheets and scored by the IBM Optical Scorer in the computer department, University of Alberta, Edmonton. The California Short-Form Test of Mental Maturity for each subject was hand scored.

The raw scores on the auditory discrimination test and the intelligence test, as well as the subject's sex, socio-economic status rating, and chronological age were punched on data cards and processed by computer services at the University of Alberta.

Item Analyses

The item analyses on the Fast-Cosens Auditory Discrimination Test consisted of five separate item analyses: one for the entire test sample population of 160 subjects and the other four for each of the kindergarten, grades one, two and three groups. This enabled the investigator to observe the subjects' performance across the grade levels and within the individual grades. It was also possible, as a result of the item analysis, to determine and order the difficulty of the test items for each grade.

Correlations

Using the total test sample, correlations were also determined between the total test scores on the Fast-Cosens Auditory Discrimination Test and the following variables: chronological age, socio-economic status, intelligence and sex. The correlations were established by using

the computer program DEST 05. The correlations tested the third hypothesis.

Stepwise Regression Analysis

This analysis indicated the rank order and the degree to which each of four selected variables would predict the total score on the Fast-Cosens Auditory Discrimination Test. The variables were: socio-economic status, intelligence, chronological age and sex.

One-Way Analysis of Variance

To test for significant differences in pupil performance on the Fast-Cosens Auditory Discrimination Test, a one-way analysis of variance with each of kindergarten, grades one, two and three groups was carried out on total pupil scores and on the following: scores for each of the sound contrasts, voiced and voiceless sounds, sounds in initial, medial and final position, and, like and unlike word-pairs. The analysis was carried out by ANOV 15, a computer program designed by the Division of Educational Research Services, University of Alberta, Edmonton. In addition to giving a one-way analysis of variance, this program includes a Scheffe Multiple Comparison Test of observed means.

Two-Way Analysis of Variance

To test the second hypothesis that all pupils performed equally well on the Fast-Cosens Auditory Discrimination Test regardless of grade, socio-economic status and sex, a two-way analysis of variance was computed by using ANOV 25, another computer program designed by the Division of Educational Research Services, University of Alberta. This analysis also determined whether there was any interaction between grade and sex,

or, between grade and socio-economic status on auditory discrimination scores.

Summary

The test sample of 160 subjects in this study consisted of kindergarten, grades one, two and three pupils randomly selected from two schools and two kindergartens designated by officials on the basis of socio-economic status.

Data collection by the investigator involved the administration of several testing instruments. Auditory discrimination scores were obtained by using the Fast-Cosens Auditory Discrimination Test. The California Short-Form Test of Mental Maturity was given to obtain an intelligence quotient for each subject. Audiometric tests were given to measure auditory acuity. By combining ratings on Blishen's (1968) Socio-Economic Index and a modified Home Index Scale (Elley, 1961), a socio-economic score was calculated for each pupil. The chronological age of each subject was obtained from the cumulative record files.

The data analysis consisted of computation of correlations, stepwise regression analysis, one-way analysis of variance, two-way analysis of variance and an item analysis.

CHAPTER IV

FINDINGS: THE ANALYSIS OF PUPIL PERFORMANCE ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

This chapter will present and analyze the data obtained in the present study which investigated the auditory discrimination ability of 160 subjects randomly selected from kindergarten, grades one, two and three. The general performance of the pupils as indicated by the total scores on the *Fast-Cosens Auditory Discrimination Test* will be examined in section one. Section two will discuss the pupil scores in terms of specific sound type contrasts included in the test items. In section three an analysis of the word-pairs will be made in order to determine the specific sounds which presented the most and least difficulty for the subjects in the present study.

I. PUPIL PERFORMANCE BY GRADES ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Results of the *Fast-Cosens Auditory Discrimination Test* as indicated by total scores, revealed the progressive ability of pupils at each successive grade level to make auditory discriminations between speech sounds. The total possible score was 266. The mean grade scores were as follows: kindergarten, 223.90; grade one, 231.28; grade two, 239.28; grade three, 243.48.

Table IX presents, in addition to the test mean for each grade, the test variance, the standard deviations, and the range of scores within each of five achievement groups. The pupils are distributed into these achievement groups on the basis of total scores on the auditory dis-

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TABLE IX

PERFORMANCE OF PUPILS BY GRADES ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Grade	No. of Pupils	Test Mean	Test Variance	Standard Deviation	Achievement Groups			
					Name	No. in Group	Range of Scores	Range in Marks
K-3	160	234.48	287.02	16.94	Upper 5	31	249-258	9
					Upper 4	31	242-248	6
					Upper 3	34	235-240	5
					Upper 2	34	225-234	9
					Upper 1	30	168-224	56
K	40	223.90	417.05	20.42	Upper 5	8	244-257	13
					Upper 4	9	232-242	10
					Upper 3	8	224-230	6
					Upper 2	7	202-219	17
					Upper 1	8	182-201	19
1	40	231.28	294.23	17.15	Upper 5	7	247-253	6
					Upper 4	8	237-246	9
					Upper 3	9	233-236	3
					Upper 2	8	225-232	7
					Upper 1	8	168-215	47
2	40	239.28	156.49	12.51	Upper 5	7	252-258	6
					Upper 4	9	244-251	7
					Upper 3	8	238-243	5
					Upper 2	9	229-236	7
					Upper 1	7	200-228	28
3	40	243.48	78.38	8.85	Upper 5	9	252-257	5
					Upper 4	6	249-251	2
					Upper 3	8	242-248	6
					Upper 2	9	236-241	5
					Upper 1	8	225-233	8

crimination test. Those in the Upper 5 group represent the top 20 per cent of pupil scores. Approximately eight pupils, or 20 per cent of the pupils are assigned to each achievement group, at each grade level, on the basis of their achievement.

The test mean of 223.90 for the kindergarten pupils indicates that these subjects were able to correctly discriminate 84 per cent of the items on the auditory discrimination test. One might assume that their language development during the preschool years has been adequate when this group is considered as a whole. The percentage of items correctly discriminated at the successive grade levels was as follows: grade one, 86 per cent; grade two, 89 per cent; grade three, 92 per cent. These findings indicate an increase in auditory discriminative ability of pupils from kindergarten through grade three. It would seem, in view of the grade means on the auditory discrimination test that these children are competent in auditory discrimination. However, the importance of the remaining 8 to 16 per cent of the speech sounds not mastered cannot be overlooked. There is always the possibility that these sounds are representative of difficulties being experienced by children in reading because of the fact that they may be sound types which are used more extensively or more frequently than those mastered. In addition to this, they could present difficulties for these pupils when it is necessary to use them in their written language forms.

Figure 2 graphically depicts the frequency distribution of the total test scores for each of the four grades, namely, kindergarten, grade one, grade two and grade three. The skewed distribution reveals a large number of high scores accompanied by a wide range in scores with perhaps the exception of grade three. It is evident that performance of

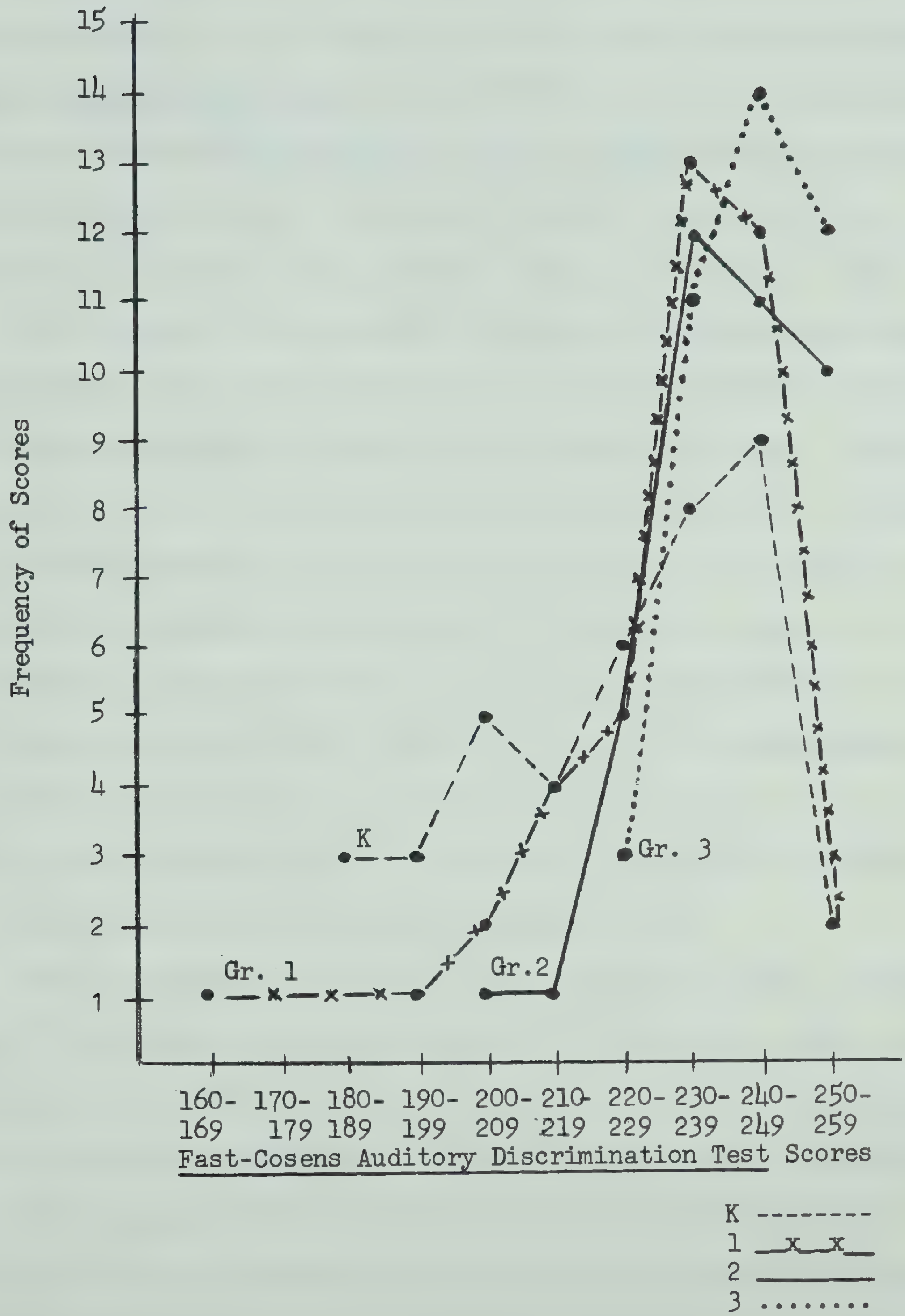

FIGURE 2

DISTRIBUTION OF SCORES ON THE
FAST-COSENS AUDITORY DISCRIMINATION TEST

the test sample on the auditory discrimination test was generally at a high level. Findings indicated that 85 per cent of the subjects in this study got between 83 and 97 per cent of the items on the Fast-Cosens Auditory Discrimination Test correct. However, in the final analysis, one cannot overlook the possibility that the items not mastered may represent those sounds most frequently used and therefore of vital importance to success in the beginning stages of learning to read.

The decrease in the standard deviation at each successive grade level indicates that the variability of the scores gradually becomes less. The standard deviations for the four grades were as follows: kindergarten, 20.42; grade one, 17.15; grade two, 12.51; grade three, 8.85. Relative to the standard deviation of 16.94 for the test sample, the grade three standard deviation indicates that the pupils' scores were closer to the mean, the dispersion and variability of scores at this grade level being much less than in any of the other grades. In summary, the developmental aspects of auditory discrimination are indicated by the increase in means, the pupils' scores coming closer to the mean and the decrease in variance at each successive grade included in the present study.

When consideration is given to the achievement groups, the range of marks in the bottom 20 per cent of pupils is least at the grade three level. The frequency distribution of scores as shown in Table X indicates that the range of scores is greatest for kindergarten and is least in grade three. The smaller range of scores in the lower achievement group of grade three, namely 225 to 233, indicates that the pupils at this grade level were a more homogeneous group in discriminating minimal word-pairs than were the pupils in kindergarten, grade one and grade two. The lowest

TABLE X

FREQUENCY DISTRIBUTION OF PUPIL SCORES ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Range of Scores	Kindergarten	Gr. 1	Gr. 2	Gr. 3	Total Sample
1 - 159	0	0	0	0	0
160 - 169		1			1
170 - 179	0	0	0	0	0
180 - 189	3				3
190 - 199	3	1			4
200 - 209	5	2	1		8
210 - 219	4	4	1		9
220 - 229	6	5	5	3	19
230 - 239	8	13	12	11	44
240 - 249	9	12	11	14	46
250 - 259	2	2	10	12	26
260 - 266	0	0	0	0	0
	40	40	40	40	160

score of 168 in grade one not only obscures the ability of the group to auditorially discriminate but it widens the range of scores in the lowest achievement group to 47. The lowest scores of 200 and 225, in grades two and three respectively, indicate a progressive increase from that of 182 in the kindergarten group. The highest score of 258 occurred at the grade two level. However, total scores of 257 were made by pupils in both kindergarten and grade three. There is an absence of scores in the 260 to 266 range at all four grade levels. The narrowing range of scores between kindergarten and grade three, with the exception of grade one and its one extremely low score, is due to a higher level of performance in the lowest achievement group at each grade level. In summary, the mean grade scores, test variances, standard deviations and range of scores as presented in Table IX indicate that there is generally a steady progression in ability of pupils from kindergarten through grade three to make auditory discriminations between speech sounds.

II. PERFORMANCE OF PUPILS BY SPECIFIC SOUND TYPES

The scores on the Fast-Cosens Auditory Discrimination Test were analyzed in three ways in order to determine the ability of the pupils in each grade to discriminate specific types of sounds. Consideration in the analyses was given to sound contrasts, voicing, and position of sound in the word.

Sound Contrasts

The 133 unlike word-pairs were examined according to the following types of sounds: stops, nasals, fricatives, affricates, semivowels and lateral. The mean sound contrast scores for each type of sound was

calculated by utilizing the difficulty indices in the item analysis. The difficulty index for each test item on the Fast-Cosens Auditory Discrimination Test was obtained from the item analyses which were programmed for each grade level by the Division of Educational Research Services, University of Alberta. The difficulty of a test item is usually expressed as the proportion of a certain sample who respond to it correctly (Davis, 1966:281-285). It is within this context that the investigator refers to the difficulty index of a test item. A difficulty index of .850 would indicate that 850 out of 1,000 responses, or 85 per cent of the responses on that specific test item were correct. Auditory discrimination performance at each grade level on the unlike word-pairs indicated that some types of sounds were more difficult than others. Table XI shows the mean proportion of each sound contrast that was mastered at each grade level. The findings for any one type of sound contrast indicate that there is generally an increase in the ability of pupils from kindergarten through grade three to discriminate between the various sound contrasts included in the Fast-Cosens Auditory Discrimination Test. As shown in Table XI, the difficulty indices for the nasal-nasal sound contrasts were .752, .791, .859 and .884 for kindergarten, grade one, grade two and grade three respectively. This could be indicative of the developmental nature of auditory discrimination which has been postulated by previous researchers (Kennedy, 1942; Wepman, 1960; Thompson, 1962; Poling, 1968; Fast, 1968).

Most Difficult Sound Contrasts. When consideration was given to the test sample, the most difficult items were those involving stop contrasts. Only 81 per cent of the subjects got the twenty-four items correct. Although only 76 per cent of the kindergarten pupils were able to correctly discriminate the sound contrasts involving stops, the

TABLE XI

ORDER OF DIFFICULTY OF TYPES OF SOUNDS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Ordered Difficulty	Kindergarten	Grade One	Grade Two	Grade Three	Test Sample
Most Difficult	Nasal-Nasal .752	Nasal-Nasal .791	Stop-Stop .854	Stop-Stop .807	Stop-Stop .810
	Stop-Stop .765	Stop-Stop .815	Nasal-Nasal .859	Nasal-Nasal .884	Nasal-Nasal .821
	Semiv-Semiv .800	Semiv-Semiv .825	Semiv-Semiv .900	Fric-Fric .912	Semiv-Semiv .862
	Fric-Fric .806	Fric-Fric .834	Fric-Fric .909	Semiv-Semiv .925	Fric-Fric .865
	Stop-Fric .839	Affr-Fric .862	Affr-Fric .920	Stop-Fric .927	Affr-Fric .892
	Affr-Fric .849	Semiv-Lat .872	Semiv-Lat .937	Affr-Fric .936	Stop-Fric .898
Least Difficult	Semiv-Lat .859	Stop-Fric .886	Stop-Fric .939	Semiv-Lat .944	Semiv-Lat .903

Semivowel - Semiv
Fricative - Fric
Affricate - Affr
Lateral - Lat

[illegible]

difficulty indices of .815 and .854 at the grade one and two levels, respectively, indicate that the pupils exhibited increased ability at the successive grade levels in the discrimination of stop contrasts, the greatest increase occurring between kindergarten and grade one. This is possibly due to the emphasis placed on final consonants in most instructional programs in reading during the first year of school. The stop contrasts continued to present difficulty for the grade three pupils, however, as is shown by the difficulty index of .807.

The second most difficult sound contrast for the subjects in the test sample to discriminate were the nasals. However, the difficulty indices of .752, .791, .859, and .884 indicate that there was a progressive increase in the ability of the pupils from kindergarten through grade three to discriminate between the nasal sound contrasts. The greatest increase occurred between grades one and two.

The indices of .862 and .865 in the discrimination of sound contrasts involving semivowels and fricatives, respectively, indicate that there was only a slight difference in the performance of the subjects in the test sample on items involving these two sound types. The developmental nature of auditory discriminative ability is indicated by increased scores on both types of sounds at each successive grade level. Similar to sound contrasts involving nasals, the greatest increase in discriminative ability occurred between grade one and grade two.

When consideration was given to grades, the nasal comparisons were the most difficult sound contrasts to discriminate in kindergarten and grade one. The pupils had to discriminate between eleven unlike word-pairs in the nasal category. Of these 75 per cent of the subjects in kindergarten and 79 per cent of the subjects in grade one answered

the items correctly. The most difficult sound contrasts for pupils in grades two and three were the stops. In grade two, 85 per cent of the pupils gave the correct response on the items involving stop contrasts. Of the twenty-four stop comparisons, 80 per cent of the grade three pupils got the items correct.

The second most difficult sound contrast to discriminate in kindergarten and grade one was the stops, whereas in grades two and three, nasals were second in difficulty. Blank (1968) has suggested that in the perception process, as applied to reading, there is a tendency to focus on the beginnings of words and from there on children use context clues. As a result attention is not focused on the whole word, or more specifically, on the ending. This might partially explain the difficulty that the subjects exhibited in discriminating stops. Relative to the difficulty the pupils experienced in the discrimination of nasals, it is possible that discriminative characteristics are less distinct in nasals than in other types of sounds. There is no movement of the articulator and the nasal consonants are resonated in part in the nasopharynx and nasal cavity through which the air escapes in phonation.

<u>Least Difficult Sound Contrasts</u>. The easiest items for the subjects in the test sample to discriminate were those involving the semivowel-lateral sound contrasts. As shown by the difficulty index of .903, 90 per cent of the pupils gave the correct response. The greatest increase in ability to discriminate between these sound types again occurred between grade one and grade two. The higher level of pupil performance at each successive grade level suggests the developmental nature of auditory discrimination. In the stop-fricative and affricate-fricative sound contrasts, the difference in the discriminative ability of the

pupils in the test sample was minimal as shown by the difficulty indices of .898 and .892. The performance of the pupils in grade three was slightly below that of the grade two pupils in the discrimination of stop-fricative sound contrasts, however.

When consideration was given to grade, and ease of difficulty, the semivowel-lateral comparisons appeared to be the easiest items for both kindergarten and grade three pupils to discriminate. In grades one and two, however, the pupils' performance was highest on the items involving stop-fricative comparisons. Of the twenty-three items in which it was necessary to discriminate between stop-fricative sounds, the pupils in grade one and grade three got 88 per cent and 92 per cent, respectively of the items correct. The grade two pupils gave correct responses to 94 per cent of the stop-fricative comparisons. It should be noted that in grade two, the difference in discriminating correctly between semivowel-lateral and stop-fricative comparisons is minimal, namely .002. Subjects in three of the four grades evidently found the semivowel-lateral comparisons easy to discriminate.

The findings indicate that in some instances, there was very little difference between the performance of subjects in grades two and three when discriminating between the various types of sounds. If, as it has been suggested, auditory discrimination may mature as late as the seventh or eighth year, these findings are not too surprising. The mean chronological ages for the grades two and three pupils were 7.9 years and 9.01 years respectively. This indicates that the grade two children were almost eight years old. It is possible that their auditory discrimination ability has matured and that, consequently, they are in some instances as competent in auditory discrimination as the grade three

pupils. Although there was no significant difference between performance of grade two and grade three pupils on some types of sounds, the fact must not be overlooked that the children at these grade levels still require training in auditory perception.

The mean intelligence scores of 110.92 and 108.75 for grades two and three, respectively, could also be influential factors in the auditory discrimination performance of the children at these grade levels. There is a difference of 2.17 between the mean intelligence score of the pupils in these two grades. If, as research (Wheeler and Wheeler, 1954; Dykstra, 1966; Fast, 1968) has indicated, there is a positive relationship between intelligence and auditory discrimination, and auditory maturation has taken place, we might expect the grade two pupils to essentially be equally competent in auditory discriminative ability.

Voicing

Table XII shows the mean performance of pupils in the test sample and in each grade on the sound contrasts when consideration was given to voicing.

The developmental aspects of auditory discrimination are, generally, indicated by the higher level of pupil performance in each successive grade when the additional axis of voicing is added. Findings revealed that there was a slight tendency to hear differences between two voiceless sounds more easily than between two voiced sounds. The greater increases occurred between grades one and two in discriminating between the sounds the pupils found more difficult. As can be seen in Table XII, the difficulty indices for the voiced stops were as follows: kindergarten .744, grade one .778, grade two .831 and grade three .820. Similarly in the discrimination of voiced nasals, the greatest increase occurred between

TABLE XII

ORDER OF DIFFICULTY OF VOICED (vd) AND VOICELESS (vl) TYPES OF SOUNDS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Ordered Difficulty	Kindergarten	Grade One	Grade Two	Grade Three	Test Sample
Most Difficult	vd Fric-Fric .707	vd St-St .778	vl St-St .831	vl St-St .800	vd St-St .793
	vd St-St .744	vd Fric-Fric .787	vd Fric-Fric .840	vd St-St .820	vd Fric-Fric .794
	vd Na-Na .752	vd Na-Na .791	vd Na-Na .859	vd Fric-Fric .842	vl St-St .819
	vl St-St .773	vd Semiv-Semiv .825	vl St-St .868	vd Na-Na .884	vd Na-Na .821
	vd Semiv-Semiv .800	vd Affr-Fric .832	vd Affr-Fric .895	vd St-Fric .920	vd Semiv-Semiv .862
	vd Affr-Fric .818	vl St-St .837	vd Semiv-Semiv .900	vd Semiv-Semiv .925	vd Affr-Fric .874
	vd Stop-Fric .839	vl Fric-Fric .851	vd St-Fric .933	vl Affr-Fric .936	vl Fric-Fric .891
	vl Fric-Fric .843	vd Semiv-Lat .872	vl Fric-Fric .934	vl Fric-Fric .938	vd St-Fric .893
	vd St-Fric .845	vd St-Fric .875	vd Semiv-Lat .935	vl St-Fric .941	vd Semiv-Lat .903
	vd Semiv-Lat .859	vl Affr-Fric .889	vl Affr-Fric .939	vd Semiv-Lat .944	vl Affr-Fric .909
Least Difficult	vl Affr-Fric .872	vl St-Fric .906	vl St-Fric .950	vd Affr-Fric .950	vl St-Fric .909

Voiced - vd Stop - St Semivowel - Semiv Fricative - Fric
Voiceless - vl Nasal - Na Affricate - Affr Lateral - Lat

grades one and two, as shown by the following difficulty indices: kindergarten, .752; grade one .791; grade two .859; grade three .884. However, in the voiceless stops, the greatest increase in pupil performance occurred between kindergarten and grade one; kindergarten .773; grade one .837; grade two .868; grade three .800. This same trend was also evident in the voiceless stop-fricative sound contrasts.

Generally, the subjects in the test sample performed better on the voiceless than on the voiced sound contrasts as measured by the Fast-Cosens Auditory Discrimination Test. These findings agree with those of Fast (1968:97) and Cosens (1968:112) who also found that voiceless sounds were easier to discriminate than voiced sounds in their investigations of auditory discrimination. As stated previously, this could have been due to the fact that voiceless sounds are more intense and noisy than are voiced sounds, and therefore are easier to hear. As indicated in Table XII, the performance of the pupils in terms of voiceless and voiced sounds within the sound categories generally shows an increase in auditory discrimination ability at each successive grade level. That is, the developmental aspects of auditory discrimination continue to be evident even when the voicing axis is added to the specific types of sounds.

There is a gradual and definite progression from kindergarten through grade three in the ability to discriminate the following sound contrasts: voiced nasals, voiced semivowel-laterals, voiced fricatives, voiceless fricatives, voiced affricate-fricatives, and voiced semivowels. The voiced sounds tend to be more difficult to discriminate than the voiceless sounds. In the discrimination of the sound types as shown in Table XII, the pupils continued to manifest increased ability from

kindergarten through grade two. In the voiceless stops and voiced nasal sound contrasts, however, the grade two pupils were superior to the grade three pupils in auditory discrimination. The difference in auditory discriminative ability between these two grades was minimal in voiced stops, voiceless affricate-fricatives, and voiced and voiceless stop-fricatives.

The most difficult sounds for the kindergarten children to discriminate were the voiced fricatives. Miller and Nicely (1961:165) have stated that voiced fricatives are difficult sounds to hear. They have suggested that discrimination of both voiced and voiceless fricatives depends more on verbal content and watching the speaker's lips than on the acoustical difference. Therefore the taped word-pair test would afford no such opportunity. Also, voiceless consonants are more intense and noisy than are the voiced consonants. This may partly account for the better pupil performance in kindergarten in dsicriminating between voiceless than in discriminating between voiced speech sounds.

Templin (1957:60) found that voiceless fricatives were produced more accurately than the voiced fricatives. Research (Miller and Nicely, 1961; Wepman, 1961) has indicated that there is a close relationship between articulated speech and the auditory discrimination of speech sounds. As one might then expect, the voiceless affricate-fricative comparisons were most easily discriminated by the kindergarten pupils. In her investigation of children's speech, Templin (1957:56) also found that the three-to-eight year old subjects made twenty-five as many errors in fricatives than they did in articulation of nasals. However, if as she stated, children are able to articulate the affricate /č/ at the age of 4.5 years, discriminating between affricate-fricative sound contrasts

might be a relatively easy task for young children. Also, as Denes and Pinson (1963:137) have stated, duration and formant transitions play an important part in speech recognition. If so, the specific fricative and the neighbouring vowel would be important factors in the ease of discriminating between the unlike word-pairs.

When consideration is given to voicing, the kindergarten pupils performed better on the voiceless than on the voiced sounds except in the stop-fricative comparisons.

In grades one and two, the voiced stop comparisons were the most difficult to discriminate. The difficulty indices for these were .778 and .831 for pupils in grade one and grade two, respectively. However, in grade three the sound contrasts involving voiceless stops proved most difficult. The pupils gave correct responses to only 80 percent of the items. Templin (1957:58) found in her investigation of children's speech that the number of errors by age decreased for all sound categories, with the exception of plosives. There was no trend in the production of plosives with subjects between the ages of six and eight.

Denes and Pinson (1963:131) have attempted to explain the difficulty encountered in identifying plosives, or stops in speech. In an experiment using a particular machine called the Pattern-Playback, test syllables consisting of a stop and a vowel were presented to a group of listeners. The stops were "centred" at a number of frequencies. The experimenters reported that:

> No single plosive burst was consistently heard as the same plosive consonant. For example, a plosive burst centred at one frequency was heard as a "k" when associated with one vowel, and as a "p" when associated with another vowel. In other words, the kinds of plosive consonant we hear depends not only on the frequency of the plosive burst, but also on the nature of the following vowel. (Denes and Pinson, 1963:132)

It would seem, therefore, that phonemic environment is an important factor in the discrimination of plosives and other speech sounds, both voiced and voiceless.

The easiest items for pupils in grades one and two, when voicing was considered, were the voiceless stop-fricative comparisons. In grade one, 91 per cent of the pupils gave the correct responses and in grade two, 95 per cent of the pupils got the items correct. The voiced affricate-fricative word pairs were the easiest items for the grade three pupils.

An analysis of the scores of the test sample indicated that the subjects in this investigation performed best on the voiceless affricate-fricative and the voiceless stop-fricative items. The voiced stop and voiced fricative comparisons were equally most difficult. In summary, the subjects performed better on the voiceless than on the voiced sound contrasts.

Position of Sound in Word

Table XIII shows the mean performance of the test sample and of each of the grades when consideration is given to position of sounds in the unlike word-pair items on the *Fast-Cosens Auditory Discrimination Test*.

The difficulty indices as shown in Table XIV indicate that there was an increase in pupil performance at each successive grade level in the discrimination of sounds in initial, medial and final positions. Pupil performance in discriminating between sounds in the final position, although the most difficult of all three positions, showed a developmental trend: kindergarten .785; grade one .846; grade two .885; grade three .888.

When the difficulty indices are used as a basis of comparison

TABLE XIII

MEAN PERFORMANCE OF PUPILS ON POSITION OF SOUNDS IN WORDS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Position of Sound in Word Contrasted	No. of Test Items	Mean Performance									
		Grade:	Kindergarten		Grade One		Grade Two		Grade Three		Test Sample
			Mean	%	Mean	%	Mean	%	Mean	%	Mean	%
Initial	39		31.80	82%	33.73	86%	35.15	90%	35.60	91%	34.07	87%
Medial	33		27.85	84%	28.45	86%	30.98	94%	31.40	95%	29.67	90%
Final	61		47.88	78%	51.93	85%	53.95	89%	54.70	90%	52.11	85%
Total Test Items	133											

TABLE XIV

ORDER OF DIFFICULTY ON POSITION OF SOUNDS IN WORDS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Ordered Difficulty	Grades				Test Sample
	Kindergarten	Grade 1	Grade 2	Grade 3	
Most Difficult	Final .785	Final .846	Final .885	Final .888	Final .851
	Initial .815	Medial .848	Initial .901	Initial .906	Initial .868
Least Difficult	Medial .839	Initial .856	Medial .939	Medial .940	Medial .891

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

between the subjects in the total test sample and the subjects in each grade, the order of difficulty of initial, medial and final sounds which was found for the entire sample holds at each of the grade levels with the exception of grade one. As is shown in Table XIV these pupils showed little difference in their ability to discriminate initial, medial or final sound contrasts. The difficulty index of .851 for final sounds indicated that the subjects in the total test sample found this position most difficult. The difficulty index of .891 indicates that medials were the easiest to discriminate of all sounds. Therefore, the order of difficulty for the subjects in this study, when position of sound is considered, was as follows: final, initial and medial. Cosens (1968: 114) in a study which investigated the effect of auditory discrimination training with sixty grade one subjects similarly found that final sounds were the most difficult to discriminate and medial sounds easiest to discriminate when consideration was given to position of sound. In another study which investigated the auditory discrimination ability of grade one children, Fast (1968:109) found that sounds in the final position posed the greatest difficulty. However, initial sounds were the easiest to auditorially discriminate.

Table XV shows each of the sound positions compared, the various sound categories, the number of test items included in each of the sound positions and the difficulty indices for each grade. Table XVI summarizes the findings relative to type and position of sound in the word-pairs by presenting the three most difficult and three least difficult sound type contrasts for pupils in the test sample. Those sound types which proved most difficult for the kindergarten pupils were the final stops, the final nasals, and the medial nasals. The medial fricatives, initial semivowel-

TABLE XV

COMPOSITE DIFFICULTY INDICES OF POSITION OF SOUNDS IN WORDS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Type of Sound	No. of Test Items in Each Position	Grade	Initial (39)	Medial (33)	Final (61)
Stop-Stop Contrasts	*I.-0	K		.846	.735
	M.-6	1		.875	.809
	F.-18	2		.958	.819
		3		.942	.818
Nasal-Nasal Contrasts	I.-0	K		.750	.742
	M.-5	1		.720	.821
	F.-6	2		.895	.829
		3		.900	.871
Semivowel-Lateral Contrasts	I.-6	K	.862	.850	
	M.-2	1	.887	.825	
	F.-0	2	.946	.912	
		3	.967	.975	
Fricative-Fricative Contrasts	I.-15	K	.758	.863	.805
	M.-13	1	.843	.892	.850
	F.-20	2	.867	.963	.905
		3	.882	.962	.902
Affricate-Fricative Contrasts	I.-3	K	.858	.846	.846
	M.-7	1	.825	.853	.894
	F.-6	2	.917	.914	.929
		3	.933	.932	.942
Stop-Fricative Contrasts	I.-12	K	.856		.820
	M.-0	1	.871		.902
	F.-11	2	.919		.961
		3	.902		.960
Semivowel-Semivowel Contrasts	I.-3	K	.800		
	M.-0	1	.825		
	F.-0	2	.900		
		3	.925		

*I - Initial Position
M - Medial Position
F - Final Position

TABLE XVI

DIFFICULTY OF SOUND TYPES BY POSITION OF SOUND IN WORDS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Difficulty	GRADES							
	Kindergarten		Grade One		Grade Two		Grade Three	
3 Most Difficult Sound Types and Their Positions in Words of Test	Final Stops	.735	Medial Nasals	.720	Final Stops	.819	Final Stops	.871
	Final Nasals	.742	Final Stops	.809	Final Nasals	.829	Final Nasals	.871
	Medial Nasals	.750	Final Nasals	.821	Initial Fricatives	.867	Initial Fricatives	.882
3 Least Difficult Sound Types and Their Positions in Words of Test	Medial Fricatives	.863	Final Stop-Fricatives	.902	Medial Fricatives	.963	Medial Semi-vowel Laterals	.975
	Initial Semi-vowel Laterals	.862	Final Affricate-Fricatives	.894	Final Stop-Fricatives	.961	Initial Semi-vowel Laterals	.967
	Initial Affricate Fricatives	.858	Medial Fricatives	.892	Medial Stops	.958	Medial Fricatives	.962

[illegible]

laterals, and initial affricate-fricatives were the three least difficult sound contrasts.

Templin (1957:60) found that children had considerably less difficulty articulating sounds in the initial and medial position in words than they did in articulating sounds in the final position. Perhaps, then, the speech sounds which children articulate correctly are those they most easily discriminate.

The most difficult sound types for grade one pupils were the same as for the kindergarten pupils: medial nasals, final stops and final nasals. The least difficult sound types for pupils in grade one were those in which they had to discriminate between sound contrasts in the final stop-fricative, final affricate-fricative and medial fricative word contrasts.

In grades two and three the most difficult sound types to discriminate were those involving final stops, final nasals, and initial fricatives. Research of Miller and Nicely (1961:166) indicated that the distinctions between /θ/ and /f/, and between /ð/ and /v/ were among the most difficult to hear. They stated that the differentiation depends more on verbal context and on visual observation of the speaker's lips than it does on the acoustical difference. In view of the difficulty associated with discriminating between these particular phonemes, one might expect children to experience more difficulty with fricatives on a taped test, such as the Fast-Cosens Auditory Discrimination Test. It would also appear that phonemic environment is an important factor in the ability of children to discriminate between these sound contrasts. The particular vowel sound following the consonant sound being compared may be extremely important in the pupils being able to discriminate between word-pairs.

The least difficult sound types for the grade two pupils to discriminate were the medial fricatives, final stop-fricative, and medial stop comparisons. In grade three, the medial and initial semivowel-lateral comparisons, and the medial fricative comparisons were the most easily discriminated. The medial fricative comparisons were, therefore, among the easiest items for both grades two and three. The investigator did observe that many of the subjects subvocalized the word-pairs immediately following the presentation, and manifest a rhythmic syllabication in doing so. In many cases this seemed to be related to making correct responses on comparisons involving medial sound contrasts.

In summary, it is evident then, that final stop contrasts were the most difficult to discriminate in three of the four grades, namely, kindergarten, grade two and grade three. There was no consistent pattern among the grades as relates to the least difficult items when position of sound was considered. This could be partially explained by the fact that two dimensions are operating simultaneously, namely type and position of the sound in the word. However, as indicated in Table XVI, there was an increase in discriminating final stops and final nasals at every grade level between kindergarten and grade three.

Like and Unlike Word-Pairs

The mean performance and standard deviations of the 133 unlike and 133 like word-pairs for the total test sample and for each of the grades are presented in Table XVII.

The mean performance of the test sample in discriminating the like word-pairs was 118.63 whereas the mean in discriminating unlike word-pairs was 115.90. With the exception of grade three, the mean performance for the like word-pairs is higher than that for the unlike word-pairs. At the

grade three levels, the means are practically identical. According to Vernon (1952:25) discriminating differences is a more difficult task than discriminating similarities. She outlined the following sequence of steps in perception: awareness, abstracting similarities for classification, perceiving differences and identification. Therefore, one might expect the mean in discriminating the like word-pairs to be considerably higher than the mean in discriminating unlike word-pairs, as was the case in kindergarten and grade one. However, by the end of grade three there is only a slight difference between the ability of children to discriminate between like and unlike word-pairs. It would appear that the perceptual task of hearing differences has developed to the extent that children at this grade level can discriminate equally well similarities and differences between speech sounds.

TABLE XVII

PERFORMANCE OF PUPILS BY LIKE AND UNLIKE WORD-PAIRS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

	Mean of Like Pairs	Standard Deviation	Mean of Unlike Pairs	Standard Deviation
K	116.38	10.06	107.53	15.01
Gr. 1	117.18	7.85	114.10	13.45
Gr. 2	119.20	6.47	120.08	9.37
Gr. 3	121.75	5.88	121.70	6.33
Total Sample	118.63	7.92	115.85	12.70

The following three references to "significant" differences will be shown to be statistically significant in Chapter V. The only significant difference between grades in discriminating the like word-pairs was that between kindergarten and grade three. However, in the auditory discrimination of unlike word-pairs there was

a significant difference between kindergarten and grade two, kindergarten and grade three, and, grade one and grade three. Although there was an increase in performance in discrimination, both like and unlike word pairs from one grade to the next, the increase was not statistically significant between each of the successive grade levels.

III. MOST AND LEAST DIFFICULT TEST ITEMS AS INDICATED BY PUPIL PERFORMANCE ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

For the convenience of the reader, a summary table has been devised which presents those items on which less than 70 per cent of the kindergarten pupils gave a correct response, and, compares the performance of pupils at successive grade levels on these same items. The condensed information appears in Table XXIII.

Most Difficult Test Items

Kindergarten. Those items on which less than 70 per cent of the pupils in kindergarten gave a correct response are presented in Table XVIII. The seventeen items consisted of the following distribution of sound contrasts: six fricatives, six stops, three nasals, and two stop-fricatives. Eleven of the items involved sounds in the final position, five necessitated discriminating between sounds in the initial positions and only one consisted of sound contrasts in the medial position. When voicing was considered, eleven of the items involved discrimination between voiced sound contrasts and six between voiceless sound contrasts. To summarize, the following features posed the greatest difficulty for kindergarten pupils in discriminating the most difficult word-pairs: stops, fricatives, voiced sounds, and sounds in the final position.

Of the eighteen test items, eight consisted of sound comparisons

TABLE XVIII

MOST DIFFICULT* TEST ITEMS AS MEASURED BY THE FAST-COSENS AUDITORY DISCRIMINATION TEST AT END OF KINDERGARTEN

Word-Pair	Type of Sound	Position	Voicing**	Difficulty Index
fence-thence	Fricative-Fricative	Initial	vl	.125
bad-bag	Stop-Stop	Final	vd	.350
lathe-lave	Fricative-Fricative	Final	vd	.400
clove-clothe	Fricative-Fricative	Final	vd	.450
winning-winging	Nasal-Nasal	Medial	vd	.475
rung-rum	Nasal-Nasal	Final	vd	.475
thy-vie	Fricative-Fricative	Initial	vd	.525
vow-thou	Fricative-Fricative	Initial	vd	.550
lease-leash	Fricative-Fricative	Final	vl	.550
coke-cope	Stop-Stop	Final	vl	.575
fought-thought	Fricative-Fricative	Initial	vd	.600
cap-cat	Stop-Stop	Final	vl	.600
cog-cob	Stop-Stop	Final	vd	.625
peak-peep	Stop-Stop	Final	vl	.625
sheep-sheath	Stop-Fricative	Final	vl	.625
sun-sung	Nasal-Nasal	Final	vd	.625
rub-rug	Stop-Stop	Final	vd	.650
bail-vale	Stop-Fricative	Initial	vd	.675

*Those test items on which less than 70 per cent of the subjects gave a correct response.

**vl Voiceless
vd Voiced

involving these sound contrasts is not surprising. Factors involved in the difficulty could be the phoneme environment as well as the place of articulation. The /v/ and /ð/ are both articulated in the front position of the mouth and the resulting frequency sound of each is very similar. The percentage of correct responses by the pupils in kindergarten on items involving these sound contrasts is as follows: "lathe-lave", 40 per cent; "clove-clothe", 45 per cent; "thy-vie", 52.5 per cent; "vow-thou", 55 per cent. The pupils obviously experienced more difficulty discriminating between /v/ and /ð/ in the final position than when it was in the initial position. It has been suggested that children have less difficulty with initial sounds in measures of auditory discrimination because of the fact that, in language, their attention focuses on the beginning of the words and they use context to a large extent from thereon to get the meaning of the word (Blank, 1968:1092).

The single most difficult item for the kindergarten group was "fence-thence". Only 12.5 per cent of the pupils got this item correct. The sound contrast was a voiceless stop-fricative in the initial position. The "fence-thence" word-pair was consistently the most difficult single item at every grade level in this study.

Grade One. In grade one there were twelve items on the Fast-Cosens Auditory Discrimination Test on which 70 per cent of the subjects failed to give the correct response, as compared to seventeen in kindergarten. The twelve items are presented in Table XIX.

Similar to the pattern in kindergarten, items involving the fricative /θ/ and /ð/ posed the most difficulty for pupils in grade one. A breakdown of the difficult items according to sound contrasts was as follows: four fricatives, of which three were in the final and one was

TABLE XIX

MOST DIFFICULT* TEST ITEMS AS MEASURED BY THE
FAST-COSENS AUDITORY DISCRIMINATION TEST AT END OF GRADE ONE

Word-Pair	Type of Sound	Position	Voicing**	Difficulty Index
fence-thence	Fricative-Fricative	Initial	vl	.125
clove-clothe	Fricative-Fricative	Final	vd	.325
lathe-lave	Fricative-Fricative	Final	vd	.350
lease-leash	Fricative-Fricative	Final	vl	.525
bad-bag	Stop-Stop	Final	vd	.550
winning-winging	Nasal-Nasal	Medial	vd	.550
sun-sung	Nasal-Nasal	Final	vd	.575
coke-cope	Stop-Stop	Final	vl	.620
sinner-singer	Nasal-Nasal	Medial	vd	.625
tug-tub	Stop-Stop	Final	vd	.670
brimming-bringing	Nasal-Nasal	Medial	vd	.675
lesion-legion	Affricate-Affricate	Medial	vd	.675

*Those test items on which less than 70 per cent of the subjects gave a correct response.

**vl Voiceless
vd Voiced

in the initial position; four nasals, of which three were in the medial and one was in the final position; three stops in the final position; one affricate-fricative in the medial position. Of the thirteen most difficult items, nine consisted of voiced sound contrasts and three of voiceless. The positions of sounds in the difficult items were: seven final, four medial and one initial. In summary, the main features of difficulty were found to be stops, fricatives, sounds in the final position and voiceless sounds.

The item "fence-thence" was the most difficult single item. The percentage of pupils who gave the correct response was 12.5, identical to that of the kindergarten. The second and third most difficult items were "clove-clothe" and "lathe-lave", the difficulty indices being .325 and .350 respectively.

Grade Two. Table XX presents the specific items on the *Fast-Cosens Auditory Discrimination Test* on which 70 per cent of the grade two pupils failed to give a correct response.

In grade two there were only nine items at this level of performance, whereas in kindergarten and grade one there were 17 and 12 items respectively. Eight of the nine difficult items consisted of sound contrasts in the final position. Five of the nine items necessitated discriminating between final stops. The voiceless final stops /k/, /p/, /t/, and the voiced final stops /d/, /g/, /b/ continued to be a source of difficulty, as they were in kindergarten and grade one. Similarly the items consisting of the sound contrasts of /v/ and /ð/, as in "lathe-lave" and "clove-clothe", were among the three most difficult word-comparisons for grade two pupils. The item "fence-thence" continued to be the most difficult single item. In addition to this, pupil performance dropped well

TABLE XX

MOST DIFFICULT* TEST ITEMS AS MEASURED BY THE
FAST-COSENS AUDITORY DISCRIMINATION TEST AT END OF GRADE TWO

Word-Pair	Type of Sound	Position	Voicing**	Difficulty Index
fence-thence	Stop-Fricative	Initial	vl	.075
lathe-lave	Fricative-Fricative	Final	vd	.250
clove-clothe	Fricative-Fricative	Final	vd	.525
sun-sung	Nasal-Nasal	Final	vd	.525
coke-cope	Stop-Stop	Final	vl	.550
bad-bag	Stop-Stop	Final	vd	.575
cap-cat	Stop-Stop	Final	vl	.625
shape-shake	Stop-Stop	Final	vl	.650
tug-tub	Stop-Stop	Final	vd	.675

*Those test items on which less than 70 per cent of the subjects gave a correct response.

**vl Voiceless
vd Voiced

below that of the kindergarten and grade one pupils. Only 7.5 per cent of the grade two subjects gave the correct response on this item.

The investigator found that 25 per cent of the pupils at this grade level got the "lathe-lave" item correct, while 52.5 per cent were able to correctly discriminate the sound contrasts in the item "clove-clothe". Both items consist of the fricatives /v/ and /ð/ in the final position. Also, 82.5 per cent of the pupils gave the correct response on the item "thatch-patch", whereas 92.5 per cent responded correctly on "thick-pick". These last two items involved discriminating between /θ/ and /p/ in the initial position. It would seem that vowel environment, as an important factor in auditory discrimination of speech sounds, might be indicated by the difference in the level of performance of pupils when discriminating these items. This view is supported by Denes and Pinson (1963:134-317) and Calfee and Venesky (1968:105).

Grade Three. There were eight items on the Fast-Cosens Auditory Discrimination Test on which 70 per cent of the pupils failed to give the correct response in grade three. The eight items are presented in Table XXI.

The item "fence-thence" remained the most difficult single item even for grade three pupils. However, the difficulty index did rise to a low .150. The voiced fricatives /v/ and /ð/ in the word-pairs "lathe-lave" and "clove-clothe" also continued to be two of the three most difficult items. The voiceless final stops, as in grade two, were still troublesome for pupils at this grade level. Essentially, with the omission of one item, "cat-cap", the pattern of difficulty was identical to that of the grade two group. It has been suggested that auditory discrimination is a developmental process which may mature as late as a

TABLE XXI

MOST DIFFICULT* TEST ITEMS AS MEASURED BY THE FAST-COSENS AUDITORY DISCRIMINATION TEST AT THE END OF GRADE THREE

Word-Pair	Type of Sound	Position	Voicing**	Difficulty Index
fence-thence	Fricative-Fricative	Initial	vl	.150
lathe-lave	Fricative-Fricative	Final	vd	.325
clove-clothe	Fricative-Fricative	Final	vd	.500
bad-bag	Stop-Stop	Final	vd	.550
sun-sung	Nasal-Nasal	Final	vd	.600
coke-cope	Stop-Stop	Final	vl	.625
cog-cob	Stop-Stop	Final	vd	.650
shape-shake	Stop-Stop	Final	vl	.650

*Those test items on which less than 70 per cent of the subjects gave a correct response.

**vl Voiceless
vd Voiced

child's seventh or eighth year. Based upon this assumption, one might expect an insignificant difference in the performance between grades two and three pupils. The mean chronological ages of the pupils in the four groups were as follows: kindergarten, 5.8 years; grade one, 6.9 years; grade two, 7.9 years; grade three, 9.01 years.

The difficulty indices of the items on which 70 per cent of the pupils, at the end of grade three, gave incorrect responses are presented for each grade in Table XXII. As can be seen, all eight items proved difficult for each of the four groups. Although performance on the items was somewhat erratic from grade to grade, the fact remains they were generally troublesome for the pupils. It would seem that these specific final voiced stops and final voiced fricatives need special attention in the auditory training program.

Summary

As indicated by the findings, initial, voiceless fricative sounds were the less difficult features of sound contrasts in discriminating the word-pairs. However, "fence-thence", which contains the above characteristics, was the single most difficult test item in kindergarten, grades one, two and three. On the other hand, consistent patterns of difficulty reappeared in many of the most difficult test items. The voiced, final, stop sound contrast in the test item "bad-bag", was representative of a difficulty common to the subjects, generally, in the test sample. Similarly, the test items "coke-cope", and "sun-sung", were consistently difficult for pupils in all grades. These specific items consisted of stop and nasal contrasts which were difficult for all grades. When consideration is given to the test items in Table XXIII, it would seem that, if the possibility of poor taping is ruled out, these word-pairs

TABLE XXII

DIFFICULTY INDICES BY GRADES OF MOST DIFFICULT* TEST ITEMS AS MEASURED BY THE FAST-COSENS AUDITORY DISCRIMINATION TEST AT THE END OF GRADE THREE

Word-Pair	Type of Sound	Position	Voicing	K	GR 1	GR 2	GR 3
fence-thence	Fricative-Fricative	Initial	vl	.125	.125	.075	.150
lathe-lave	Fricative-Fricative	Final	vd	.400	.350	.250	.325
clove-clothe	Fricative-Fricative	Final	vd	.450	.325	.525	.500
bad-bag	Stop-Stop	Final	vd	.350	.550	.575	.550
sun-sung	Nasal-Nasal	Final	vd	.625	.575	.525	.600
coke-cope	Stop-Stop	Final	vd	.575	.625	.550	.525
cog-cob	Stop-Stop	Final	vd	.625	.700	.700	.650
shape-shake	Stop-Stop	Final	vl	.700	.725	.650	.650

*Those test items on which less than 70 per cent of the subjects gave a correct response.

*vl Voiceless
vd Voiced

represent specific sound contrasts which require special attention in the auditory perception training program. Of the eighteen test items in Table XXIII, only three are multi-syllabic. As stated previously in this chapter, the pupils subvocalization of the word-pairs in a rhythmic syllabication immediately following their presentation on the tape, appeared to be associated with the pupils making the correct response.

Least Difficult Test Items

The items which presented least difficulty for the subjects in this study were regarded as those in which 95 per cent or more of the pupils made the correct responses.

In kindergarten there were fourteen such items. Two of the fourteen items were correctly discriminated by all subjects. These were "pie-thigh" and "sheaf-thief". Table XXIV presents the least difficult items for kindergarten. All but three of the easiest fourteen word-pairs involved fricative sound contrasts. Only one stop and one nasal contrast were found among the least difficult items at this grade level. This suggests that these sounds were difficult for the kindergarten pupils. Only one of the fourteen easiest items consisted of sound contrasts in the final position. Voiceless sound contrasts were found to be more in number than voiced sound contrasts. It would seem then, that kindergarten pupils found voiceless, initial and medial sounds least difficult to discriminate.

In grade one, 95 per cent or more of the pupils gave the correct responses on twenty-three items. Three of these items were correctly discriminated by all of the pupils. These items were "leap-leaf", "sheaf-thief", and "bathe-bade".

All of the forty grade two pupils were able to correctly

TABLE XXIII

DIFFICULTY INDICES BY GRADES OF MOST DIFFICULT* TEST ITEMS AS MEASURED BY THE FAST-COSENS AUDITORY DISCRIMINATION TEST AT END OF KINDERGARTEN

Word-Pair	Type of Sound	Position	Voicing	Difficulty Indices K	GR 1	GR 2	GR 3
fence-thence	Fricative-Fricative	Initial	vl	.125	.125	.075	.150
bad-bag	Stop-Stop	Final	vd	.350	.550	.575	.550
lathe-lave	Fricative-Fricative	Final	vd	.400	.350	.250	.325
clove-clothe	Fricative-Friactive	Final	vd	.450	.325	.525	.500
winning-winging	Nasal-Nasal	Medial	vd	.475	.550	.700	.800
rung-rum	Nasal-Nasal	Final	vd	.475	.775	.750	.850
thy-vie	Fricative-Fricative	Initial	vd	.525	.900	.800	.800
vow-thou	Fricative-Fricative	Initial	vd	.550	.800	.775	.900
lease-leash	Fricative-Fricative	Final	vl	.550	.525	.900	.800
coke-cope	Stop-Stop	Final	vl	.575	.620	.550	.625
fought-thought	Fricative-Fricative	Initial	vd	.600	.700	.775	.900
cap-cat	Stop-Stop	Final	vl	.600	.700	.625	.725
cog-cob	Stop-Stop	Final	vd	.625	.700	.700	.650
peak-peep	Stop-Stop	Final	vl	.625	.775	.825	.775
sheep-sheath	Stop-Fricative	Final	vl	.625	.825	.775	.925
sun-sung	Nasal-Nasal	Final	vd	.625	.575	.525	.600
rub-rug	Stop-Stop	Final	vd	.650	.700	.800	.775
bail-vale	Stop-Fricative	Initial	vd	.675	.875	.825	.850

*Those test items on which less than 70 per cent of the subjects gave a correct response.

TABLE XXIV

LEAST DIFFICULT* TEST ITEMS AS MEASURED BY THE FAST-COSENS AUDITORY DISCRIMINATION TEST AT THE END OF KINDERGARTEN

Word-Pair	Type of Sound	Position	Voicing**	Difficulty Index
sheaf-thief	Fricative-Fricative	Initial	vl	1.000
pie-thigh	Stop-Fricative	Initial	vl	1.000
sheep-cheap	Affricate-Fricative	Initial	vl	.975
lath-lash	Fricative-Fricative	Final	vl	.975
lasses-lashes	Fricative-Fricative	Medial	vl	.975
has-had	Stop-Fricative	Final	vd	.975
ban-van	Stop-Fricative	Initial	vd	.975
singer-simmer	Nasal-Nasal	Medial	vd	.975
ring-wing	Semivowel-Semivowel	Initial	vd	.950
shack-sack	Fricative-Fricative	Initial	vl	.950
day-they	Stop-Fricative	Initial	vd	.950
region-reason	Affricate-Fricative	Medial	vd	.950
rocking-rotting	Stop-Stop	Medial	vl	.950
muscle-muffle	Fricative-Fricative	Medial	vl	.950

*Those items on which 95 per cent or more of the subjects made the correct responses.

**vl Voiceless
vd Voiced

discriminate twenty items on the Fast-Cosens Auditory Discrimination Test. There was a total of seventy-one items on which 95 per cent or more of the pupils at this grade level made the correct auditory discriminations.

At the grade three level, only fourteen items were correctly discriminated by all subjects. However, the total number of items on which 95 per cent or more of the pupils got the items correct increased from seventy-one in grade two to eighty-three in grade three.

Table XXV presents a summary of those items on which 95 per cent or more of the kindergarten subjects made the correct responses, and compares the performance of pupils at successive grade levels on these same items. The difficulty indices indicate that the subjects at all grade levels experienced little difficulty in discriminating between the sound type contrasts in these particular word-pairs. Findings indicated that items consisting of word-pairs involving fricative sound type contrasts were high on the list of both the least difficult and most difficult items for the subjects to discriminate on the Fast-Cosens Auditory Discrimination Test. It would seem that features such as phonemic environment and point of articulation are important factors in chidren's ability to make auditory discriminations.

Summary

Analysis of the test scores on the Fast-Cosens Auditory Discrimination Test indicated that the range of scores was from 168 to 258. When considering total scores by grades, there was a difference between kindergarten and grade two, kindergarten and grade three, grade one and grade three which will be shown to be statistically significant in Chapter V.

The following sound contrasts proved most difficult at the various levels: kindergarten and grade one, nasals; grades two and three, stops;

TABLE XXV

COMPARISON OF DIFFICULTY INDICES BY GRADES OF LEAST* DIFFICULT TEST ITEMS AS MEASURED BY THE FAST-COSENS AUDITORY DISCRIMINATION TEST AT END OF KINDERGARTEN

Word-Pair	Type of Sound	Position	Voicing	Difficulty Indices K	Gr. 1	Gr. 2	Gr. 3
sheaf-theif	Fricative-Fricative	Initial	vl	1.000	1.000	.s75	.975
pie-thigh	Stop-Fricative	Initial	vl	1.000	.950	.975	.950
sheep-cheap	Affricate-Affricate	Initial	vl	.975	.950	.875	.950
lath-lash	Fricative-Fricative	Final	vl	.975	.975	.975	1.000
lasses-lashes	Fricative-Fricative	Medial	vl	.975	.925	.975	.925
had-has	Stop-Fricative	Final	vd	.975	.925	1.000	.925
ban-van	Stop-Fricative	Initial	vd	.975	.800	.950	.950
singer-simmer	Nasal-Nasal	Medial	vd	.975	.825	1.000	.975
ring-wing	Semivowel-Semivowel	Initial	vd	.950	.975	1.000	.975
shack-sack	Fricative-Fricative	Initial	vl	.950	.925	.975	.975
day-they	Stop-Fricative	Initial	vd	.950	.900	.975	.950
region-reason	Affricate-Fricative	Medial	vd	.950	.975	1.000	.975
rocking-rotting	Stop-Stop	Medial	vl	.950	.925	.975	1.000
muscle-muffle	Fricative-Fricative	Medial	vl	.950	.950	.975	1.000

*Those items on which 95 per cent or more of the subjects made the correct responses.

total test sample, stops. The easiest sounds to discriminate were: kindergarten and grade three, semivowel-lateral comparisons; grades one and two, stop-fricative comparisons; total test sample, semi-vowel lateral comparisons. A careful examination of the tables presented in this chapter revealed that in many instances, the differences between performance in several of the sound type categories were minimal.

When voicing and type of sound were considered together, the following were most difficult: kindergarten, voiced fricatives; grades one and two, voiced stops; grade three, voiceless stops. Findings indicated that the easiest sound comparisons were: kindergarten, voiceless affricate-fricatives; grades one and two, voiceless stop-fricatives; grade three, voiced affricate-fricatives; total test population, voiceless stop-fricatives and affricate-fricatives.

When consideration was given to position and type of sound, kindergarten pupils experienced most difficulty with final stops. In grade one, medial nasals were most difficult. The final stops and final nasals presented the greatest difficulty in grades two and three. Pupils in grades one, and two found least difficulty with medial fricatives. The medial semivowel-lateral comparisons were most easily discriminated by pupils in grade three. For the total test sample, sounds in the final positions were most difficult and sound contrasts in the medial position were most easily discriminated.

The subjects in the test sample performed better on the discrimination of like word-pairs than on unlike word-pairs.

There are many features which contribute to the ease and difficulty of discriminability of speech sounds. Among these are type of sound, voicing, position of sound in the word, and phonemic environment. Any

analysis of auditory discrimination performance must consider more than one aspect of sounds.

Chapter VI will present the implications and conclusions arising from the findings in this analysis of the *Fast-Cosens Auditory Discrimination Test*.

CHAPTER V

THE COMPUTATION OF CORRELATIONS AND THE ANALYSES OF VARIANCE

This chapter will present the analyses of the Fast-Cosens Auditory Discrimination Test in four main sections. Correlations showing the relationship between the independent variables and the criterion or dependent variable will be discussed in section one. The stepwise regression analysis which determines the relative contribution of each of the four independent variables to the prediction of the criterion variable will be outlined in section two. In the third section, a one-way analysis of variance by grade on the total pupil scores, and on the subscores of the fourteen groups of test items will be discussed. The Scheffé Multiple Comparison Test which determines whether or not the difference between the mean grade scores is significant will also be reported. A two-way analysis of variance by grade and sex, and, grade and socio-economic status on the Fast-Cosens Auditory Discrimination Test will be presented in section four.

I. FINDINGS OF THE CORRELATIONAL ANALYSIS

According to the studies cited in Chapter II, research has been inconclusive in determining the relationship between auditory discrimination and intelligence, and, between auditory discrimination and chronological age. Therefore, correlation coefficients were used to determine the extent of relationship existing between the criterion variable, auditory discrimination, as measured by the Fast-Cosens Auditory Discrimination Test, and each independent variable in the present study: sex, chronological age, intelligence and socio-economic status, and sex. Correlation

coefficients were obtained for each grade as well as for the total test sample. These correlations are shown in Table XXVI.

An examination of Table XXVI reveals that when correlating intelligence with auditory discrimination, a significant correlation was found in all grades with the exception of grade one. Here the correlation of .298 failed to reach the level of significance. However, the correlation of .320 between auditory discrimination and intelligence for the total test sample was significant at the .01 level. This would indicate that pupils with higher intelligence performed significantly better on the Fast-Cosens Auditory Discrimination Test than did pupils with lower intelligence. Therefore, null hypothesis 3 (a) which states that there is no significant correlation between ability to make auditory discriminations and intelligence was rejected.

When considering the correlation between chronological age in months and auditory discrimination at each grade level, no significant correlation was found. At no one grade level in the present study did the older pupils perform significantly better than the younger pupils on the auditory discrimination test. As can be seen in Figure 3, the scores of the kindergarten pupils, the youngest children in the test sample, are scattered without any apparent pattern. This is indicated by the low negative correlation of -.128 between chronological age and auditory discrimination ability, as measured by the Fast-Cosens Auditory Discrimination Test. However, when the total test sample was considered, chronological age was significantly correlated with auditory discriminative ability at the .01 level of significance. Figure 3 depicts the correlations between the criterion score and chronological age for the 160 subjects in the test sample. The correlation coefficient of .427, as

TABLE XXVI

CORRELATIONS OF VARIABLES

Grade	Auditory Discrimination and Sex	Auditory Discrimination and C.A.	Auditory Discrimination and I.Q.	Auditory Discrimination and S.E.S.
Kindergarten N = 40	.144	-.128	.523**	.662**
Grade One N = 40	.208	.178	.298	.281
Grade Two N = 40	.293	.035	.529**	.543**
Grade Three N = 40	-.097	.063	.323*	.523**
Total Sample N = 160	.136	.427**	.320**	.445**

**Significant at the .01 level

*Significant at the .05 level

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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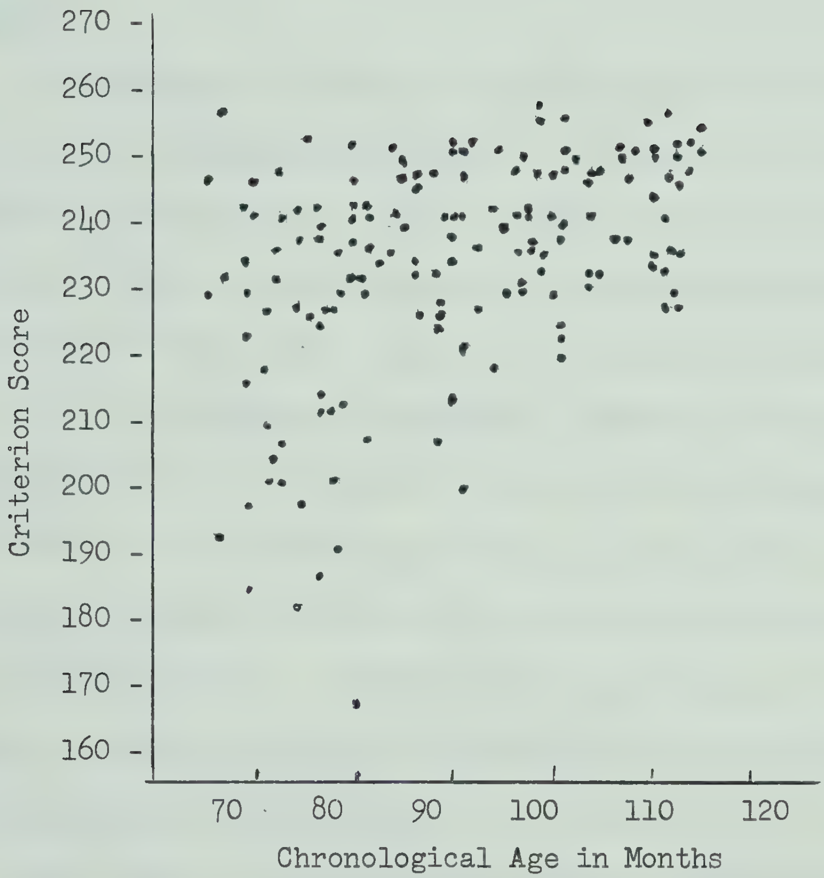

FIGURE 3

CORRELATION BETWEEN CHRONOLOGICAL AGE AND CRITERION SCORE

shown in Table XXVI, indicates that the older subjects tended to make higher scores than the younger subjects on the auditory discrimination test. Therefore, null hypothesis 3 (b) which stated that there is no significant correlation between ability to make auditory discriminations and chronological age was rejected.

Summary

Chronological age was not significantly related to auditory discrimination in kindergarten, grade one, grade two or grade three when consideration was given to the individual grades. However, the findings indicated that both chronological age and intelligence were significantly correlated to total pupil scores on the auditory discrimination test when the total test sample was considered. Significant relationships between intelligence and the criterion variable, auditory discrimination, were also found at the various grade levels in the present study, with the exception of grade one. Here the correlation coefficient of .298 failed to reach significance. Although there was little, if any, difference between the boys and girls in chronological age, the boys were more intelligent than the girls at the four grade levels. The scores of the boys were higher in both the language and non-language sections of the California Short-Form Test of Mental Maturity in kindergarten, grades one, two and three. Although the boys in the test sample achieved higher than the girls on the Fast-Cosens Auditory Discrimination Test, the difference was not significant. As shown in Table VIII, there was only a minimal difference in the socio-economic status scores of the boys and girls.

II. STEPWISE REGRESSION ANALYSIS

Stepwise regression was used to establish the contribution of each of four variables as predictors of performance on the Fast-Cosens Auditory Discrimination Test. The four variables considered were socio-economic status, intelligence, chronological age and sex. By utilizing stepwise regression analysis, it was possible to determine the rank order in which the variables contributed to the variance from the greatest to the least. The most significant predictor variable was entered first into the regression equation. At each succeeding step, another variable was added to the regression. In this way, the regression was cumulative and it was therefore possible to determine the proportion of the total variance accounted for by the variables when combined. The total sum of squares remained constant but as each predictor variable was added, the residual sum of squares was reduced.

Kindergarten

Table XXVII sets forth the regression procedure as each of the predictor variables was added step by step in an analysis of the kindergarten auditory discrimination scores.

Socio-economic status was the best single predictor of test variance at the kindergarten level. It accounted for 43.86 per cent of the total variance on the Fast-Cosens Auditory Discrimination Test. When intelligence, as measured by the California Short-Form Test of Mental Maturity was added, it yielded an additional 3.1 per cent of the total variance. As a variable by itself, I.Q. was not statistically significant. Similarly, chronological age and sex were insignificant variables by themselves, contributing only 2.07 per cent and .69 per cent respectively,

TABLE XXVII

ANALYSIS OF VARIANCE IN STEPWISE REGRESSION ANALYSIS OF KINDERGARTEN PUPILS' SCORES

		Sources of Variance (Sums of Squares)							
Step No.	Regression on Variables #4	Regression SSQ	Error SSQ	Total SSQ	Mean Square	D.F.	F	Prob.	% of Variance Accounted For
#1	4	7133.33			7133.33	1	29.69	.000**	43.86
			9130.67		240.28	38			
				16264.00		39			
#2	4 & 3	7638.57			3819.287	2	16.38	.000**	
			8625.42		233.120	37			3.11
				16264.00		39			
#3	4, 3 & 2	7973.99			2657.99	3	11.54	.000**	
			8290.00		230.28	36			2.07
				16264.00		39			
#4	4, 3, 2 & 1	8086.77			2021.69	4	8.65	.000**	
			8177.23		233.64	35			.69
				16264.00					

**Significant at .01 level.

Variables: #1 Sex
#2 Chronological Age
#3 Intelligence
#4 Socio-economic status

to the total variance. The four variables when combined accounted for 49.73 per cent of the total variance on the test scores. The total variance unaccounted for was 50.27 per cent.

Stepwise linear regression was similarly utilized to analyze the variance of the auditory discrimination scores at the grades one, two and three levels.

Grade One

Only 20.33 per cent of the total variance was accounted for by the four variables in the stepwise regression analysis of grade one scores. Findings revealed that there was no one variable statistically significant in contributing to the total variance. The I.Q. variable accounted for only 8.9 per cent. Another 4.93 per cent was accounted for by chronological age. The variables of socio-economic status and sex denoted 4.67 per cent and 1.83 per cent, respectively. Consequently, the total variance unaccounted for on the Fast-Cosens Auditory Discrimination Test scores was 79.67 per cent.

Grade Two

Socio-economic status was the variable which contributed most to test variance in grade two. As the best single predictor, it was significant at the .01 level, accounting for 29.53 per cent of the total variance. The second best single predictor was intelligence, which yielded 14.48 per cent of the test variance. Sex and chronological age, although not statistically significant, yielded 3.26 per cent and .01 per cent, respectively. When combined, the four variables accounted for 47.28 per cent of the total variance. In kindergarten, socio-economic status and intelligence accounted for 43.86 and 29.53 per cent, respec-

tively, of the total variance. However, by the end of grade two, the contribution of socio-economic status has lessened to 29.53 per cent and intelligence has risen to 14.48 per cent. At the kindergarten level it would seem that socio-economic status reflects the language development of the child and his ability to make auditory discriminations. However, after two years of experience in a school situation, the influence of the socio-economic factor does not contribute as much and intelligence begins to contribute more.

Grade Three

The order of the variables as contributing from most to least in the variability of the auditory discrimination scores was similar to that in grade two. Socio-economic status significantly predicted 27.42 per cent of the total variance. Intelligence, when entered, accounted for another 13.99 per cent, which was significant at the .01 level of confidence. Although statistically insignificant, the variables sex and chronological age contributed 2.51 per cent and .003 per cent of the total variance. The predictor variables of socio-economic status, intelligence, sex and chronological age when combined accounted for 43.92 per cent of the variance on scores of the Fast-Cosens Auditory Discrimination Test in grade three. The test variance unaccounted for was 56.08 per cent. Whereas in kindergarten socio-economic status and intelligence accounted for 43.86 per cent and 3.11 per cent, respectively, of the test variance, in grade three socio-economic status and intelligence accounted for 27.42 per cent and 3.99 per cent, respectively. Similar to the findings in grade two, the contribution of socio-economic status to the test variance has lessened and intelligence contributes more.

The results of the stepwise regression analysis of the auditory

discrimination scores as measured by the Fast-Cosens Auditory Discrimination Test in kindergarten, grades one, two and three are summarized in Table XXVIII.

Summary

Socio-economic status was found to be the most significant single predictor variable in kindergarten, grade two and grade three. Intelligence was the second most significant predictor of auditory discrimination performance in kindergarten, grades two and three. Although the variables sex and chronological age were found to have accounted for a portion of the total variance at all grade levels, their contribution failed to be statistically significant.

III. ONE-WAY ANALYSIS OF VARIANCE

Using a one-way analysis of variance, the investigator tested null hypothesis 1 (a) which stated that among children in kindergarten, grades one, two, and three, there are no significant differences in the ability of children to make auditory discriminations as indicated by their total test scores on the Fast-Cosens Auditory Discrimination Test. Table XXIX shows the mean test variance and the standard deviation of the auditory discrimination test scores for each of the four grades.

The mean grade scores as graphically depicted in Figure 4 indicated an increase in auditory discrimination ability at each successive grade level. In order to establish whether the differences between the grades were significant, the Scheffé Multiple Comparisons (Ferguson, 1966:296-298) procedure was applied. The Scheffé method may be used to make any number of comparisons between means. For the purposes of this study, the .01 and .05 levels of significance were accepted.

TABLE XXVIII

TEST VARIANCE DUE TO SOCIO-ECONOMIC STATUS, INTELLIGENCE, CHRONOLOGICAL AGE, AND SEX IN KINDERGARTEN, GRADES ONE, TWO AND THREE

Grade	% of Variance Accounted for by:		% of Variance Not Accounted For
Kindergarten	Socio-Economic Status	43.86**	
	Intelligence	3.11	
	Chronological Age	2.07	
	Sex	.69	
	Total	49.73	50.27
Grade One	Intelligence	8.90	
	Chronological Age	4.93	
	Socio-Economic Status	4.67	
	Sex	1.83	
	Total	20.33	79.67
Grade Two	Socio-Economic Status	29.53**	
	Intelligence	14.48**	
	Sex	3.26	
	Chronological Age	.01	
	Total	47.28	52.72
Grade Three	Socio-Economic Status	27.42**	
	Intelligence	13.99**	
	Sex	2.51	
	Chronological Age	.00 (.003)	56.08
	Total	43.92	

**Significant at the .01 level.

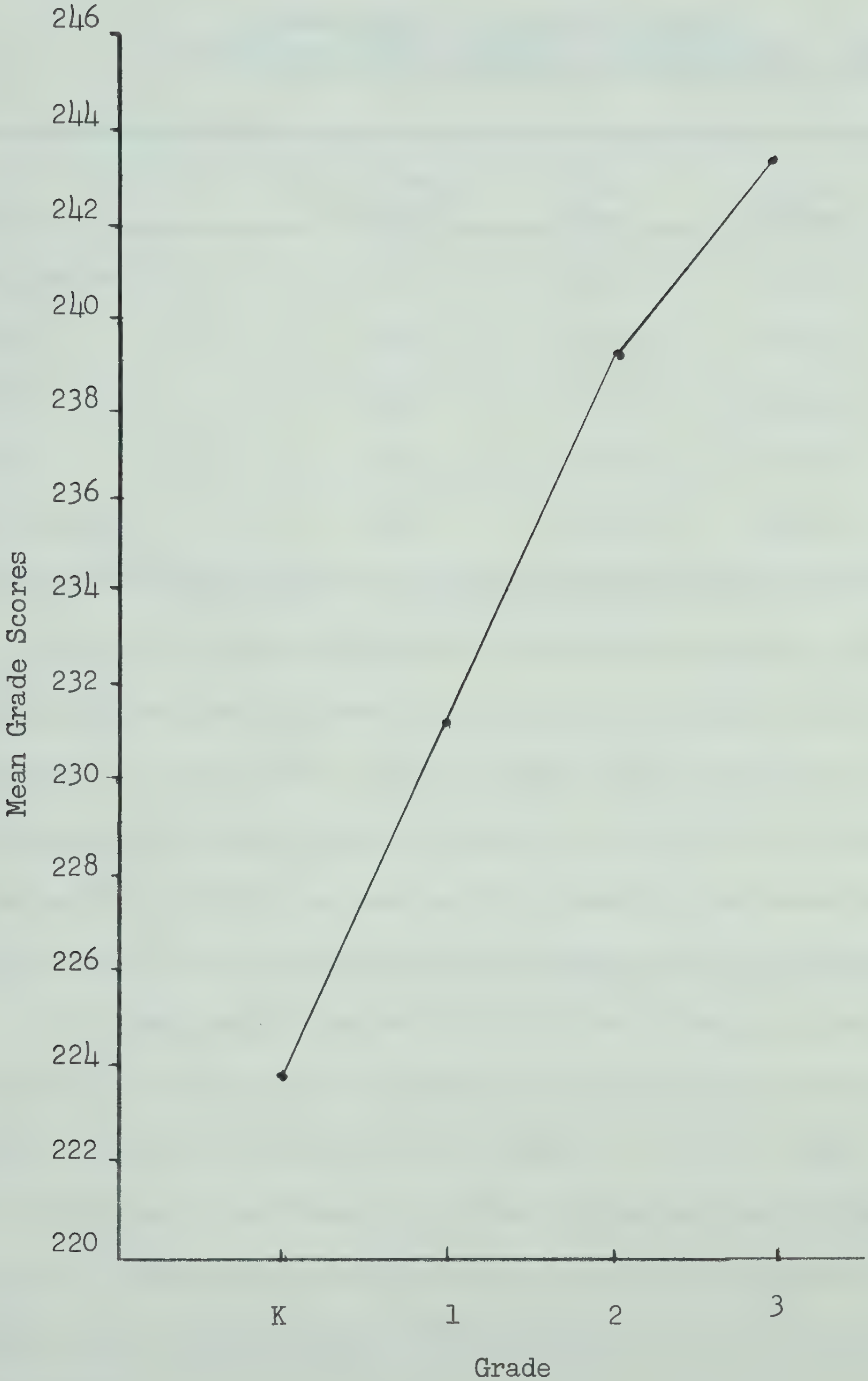

FIGURE 4

MEAN PERFORMANCE OF PUPILS BY GRADES
ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

TABLE XXIX

PERFORMANCE OF PUPILS BY GRADES
ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Grade	No. of Pupils in Grade	Test Mean	Test Variance	Standard Deviation
Kindergarten	40	223.90	417.05	20.42
Grade 1	40	231.28	294.23	17.15
Grade 2	40	239.28	156.49	12.51
Grade 3	40	243.48	78.28	8.85
Total Sample	160	234.48	287.02	16.94

Using the Scheffé Multiple Comparisons procedure, tests on differences between the grade means was carried out. The findings are summarized in Table XXX. Null hypothesis 1 (a) stated that among children in kindergarten, grades one, two and three there are no significant differences in their ability to make auditory speech discriminations as indicated by their total test scores on the Fast-Cosens Auditory Discrimination Test.

The developmental aspects of auditory discrimination from grade to grade are indicated by an increase in mean scores as follows: kindergarten, 223.90; grade one, 231.28; grade two, 239.28; grade three, 243.48. The difference in performance by total scores between kindergarten and grade two, kindergarten and grade three, grade one and grade three, were significant at the .01 level of confidence. Therefore, hypothesis 1 (a) was rejected.

There was an increase in the mean scores between each successive grade, but the difference was not statistically significant. In other words, although the pupils in grade one performed better than the kinder-

TABLE XXX

SCHEFFÉ MULTIPLE COMPARISON OF MEANS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST BY GRADES#

Measure	Grade Mean				Mean Differences Between Grades					
	K	1	2	3	K-1	K-2	K-3	GR.1-2	GR.1-3	GR.2-3
Total Score (266)	223.90	231.28	239.28	243.45	7.38	15.38**	19.55**	8.00	12.17**	4.17
Stop Contrasts (24)	18.30	19.75	20.50	20.58	1.45	2.20*	2.28*	.75	.83	.08
Nasal Contrasts (11)	8.38	8.76	9.45	9.88	.38	1.07*	1.50**	.69	1.12*	.43
Semivowel-Lateral Contrasts (8)	6.88	7.05	7.50	7.63	.17	.62*	.75**	.45	.58	.13
Fricative Contrasts (48)	38.70	41.38	43.60	44.13	2.68*	4.90**	5.43**	2.22	2.75*	.53
Affricate-Fricatives (16)	13.58	14.00	14.73	15.20	.42	1.15	1.62**	.73	1.20*	.47
Stop-Fricatives (23)	19.30	20.68	21.60	21.50	1.38*	2.30**	2.20**	.92	.82	-.10
Semivowel Contrasts (3)	2.40	2.50	2.70	2.80	.10	.30	.40*	.20	.30	.10
Voiceless Sounds (67)	55.58	59.15	61.75	62.28	3.57*	6.17**	6.70**	2.60	3.13	.53
Voiced Sounds (66)	51.95	54.95	58.33	59.43	3.00	6.38**	7.48**	3.38	4.48*	1.10
Initial Sounds (39)	31.80	33.73	35.15	35.60	1.93	3.35**	3.80**	1.42	1.87	.45
Medial Sounds (33)	27.85	28.45	30.98	31.40	.60	3.13**	3.55**	2.53**	2.95**	.42
Final Sounds (61)	47.88	51.93	53.95	54.70	4.05*	6.07**	6.82**	2.02	2.77	.75
Like Word-Pairs (133)	116.38	117.18	119.20	121.75	.80	2.82	5.37*	2.02	4.57	2.55
Unlike Word-Pairs (133)	107.53	114.10	120.08	121.70	6.57	12.55**	14.17**	5.98	7.60*	1.62

**Significant at .01

*Significant at .05

#The figures from which the Table was compiled are found in Appendix D.

garten children, and the pupils in grade three performed better than those in grade two on the auditory discrimination test, the differences were not significant. Over a period of two grades, however, the differences were significant at the .01 level.

In addition to using the total test scores, the 266 test items were grouped into fourteen subgroups, and a one-way analysis of variance was completed using subgroup scores. The subgroups consisted of all test items which were designed to test a particular sound contrast.

The mean scores of the subgroups of test items which measured particular sound contrasts are summarized in Table XXX. The figures from which Table XXX was compiled are found in Appendix D.

Specific Sound Type Contrasts

Comparisons of mean scores among the four grades were made on the following sound contrasts: stops, nasals, semivowel-laterals, fricatives, affricate-fricatives, stop-fricatives, and semivowels.

Findings as shown in Table XXX revealed that among children in kindergarten, grades one, two and three, there are significant differences in their ability to make auditory speech discriminations as indicated by their subtest scores on test items measuring the above sound contrasts. Therefore, hypothesis 1 (b) was rejected.

The mean difference between kindergarten and grade one was statistically significant at .05 level in the auditory discrimination of both fricative and stop-fricative sound contrasts. The grade two pupils were superior to the kindergarten pupils at the .01 and .05 levels of significance, in discriminating all types of sounds with the exception of semivowels and affricate-fricatives. The performance of the grade three pupils was significantly better, at the .01, and .05 levels, than the

kindergarten pupils on discriminating between items in all seven sound type categories in the auditory discrimination test. However, the difference in mean scores between grade one and grade three achieved significance, at the .01 and .05 levels, in only three sound type categories, namely, nasals, fricatives and affricate-fricatives. There was no statistically significant difference at either the .01 or .05 levels, between grade one and grade two, nor between grade two and grade three when consideration was given to auditory discrimination tasks involving the specific sound type contrasts. Findings as shown in Table XXX indicated the greatest over-all increase in auditory discrimination occurred between kindergarten and grade three. This suggests the cumulative aspect over a period of time in the development of auditory discrimination. Between kindergarten and grade three significant improvement, at the .01 and .05 levels, was shown in discriminating between all types of sounds, but especially fricatives. There was a 5.43 difference between the means of 38.70 and 44.13 for kindergarten and grade three respectively.

There were more significant differences, in the discrimination of the various types of sounds, between kindergarten and grade two than between grade one and grade three, although both intervals encompass two grades. This lends support to the argument for the early development of auditory discrimination.

Voiced and Voiceless Sounds

In discriminating between voiceless sounds, there was a significant increase, at the .01 and .05 levels, in the mean auditory discrimination test scores between kindergarten and grade one, kindergarten and grade two, and, kindergarten and grade three. Thus, hypothesis 1 (c)

which stated that among children in kindergarten, grades one, two and three, there are no significant differences in their ability to make auditory speech discriminations as indicated by their subtest scores on test items measuring voiced and voiceless sounds, was rejected. The increase in mean scores revealed the progressive development of auditory discriminative ability from kindergarten through grades one and two. These findings substantiated other research which revealed that for a number of children, adequacy in auditory discrimination is not acquired until the end of grade two (Poling, 1968). When discriminating voiced sounds, there was an increase in the mean scores at each successive grade level. However, only the difference between kindergarten and grade two, kindergarten and grade three, grade one and grade three was significant at the .05 level. The significant difference between grade one and grade three in discriminating voiced sounds, but not voiceless sounds, is probably due to voiceless sounds being easier to discriminate and consequently competence or mastery is earlier.

Sounds in Initial, Medial and Final Position

When consideration was given to position of sound in words, the findings are much the same as those for specific sound contrasts and voicing of sounds. At the .01 and .05 levels, there was a significant difference between kindergarten and grade one, kindergarten and grade two, and kindergarten and grade three when discriminating between final sounds. As stated previously, the marked increase between kindergarten and grade one is most likely due to the emphasis placed on initial and final consonants in the reading program during the first year of school. The difference in mean scores between grade one and grade two, and grade two and grade three was not of statistical significance. The develop-

mental nature of the process of discriminating between initial, medial and final sounds was shown by the increase in mean scores at each successive grade level.

The Scheffé Multiple Comparison Test also showed that there were more significant differences, at the .01 level, among grades when medial sounds were considered. The high performance of pupils at every grade level in discriminating initial sounds supports the research of Templin (1957) who found the discrimination of initial consonants a relatively easy task for first-grade children. Blank (1968) has suggested that children attend better to the beginning of words than they do to the ending. It is possible that this may partially account for the high pupil performance in discriminating between sounds in the initial position. Therefore, hypothesis 1 (d) which stated that among children in kindergarten, grades one, two and three, there are no significant differences in their ability to make auditory speech discriminations as indicated by their subtest scores on test items measuring sounds in the initial, medial and final position, was rejected.

Like and Unlike Word-pairs

An examination of the Scheffé Multiple Comparisons Test of means relative to like and unlike word-pairs revealed that the findings are generally consistent with those relating to discriminating specific sound contrasts, voiced and voiceless sounds, and position of sounds in words. At the .01 and .05 levels, there was a significant difference between kindergarten and grade three in the discrimination of both like and unlike word-pairs. Also, the performance of pupils in grade three was significantly superior, at the .01 level, to that of grade one on auditory

discrimination tasks involving unlike word pairs. The mean difference of 4.57 between grade one and grade three in discriminating between like word-pairs was not statistically significant, however. This would indicate that discriminating between like word-pairs is a relatively easy task even in grade one. Therefore, hypothesis 1 (e) which stated that among children in kindergarten, grades one, two and three there are no significant differences in their ability to make auditory speech discriminations as indicated by their subtest scores on test items measuring like and unlike word-pairs, cannot be accepted.

Summary

As a result of the one-way analysis of variance, null hypothesis 1 was rejected. Findings indicated that among children in kindergarten, grades one, two and three there are significant differences in their ability to make auditory speech discriminations as indicated by their total test scores and by their subtest scores on test items measuring specific sound type contrasts, voiceless and voiced sounds, sound in the initial, medial and final position in words, and like and unlike word-pairs.

II. TWO-WAY ANALYSIS OF VARIANCE

The investigator used a two-way analysis of variance to test for interaction between sex and grade, and, the main effect due to sex on the Fast-Cosens Auditory Discrimination Test scores.

The lines plotted in Figure 5 depict the mean scores of the boys and girls at each grade level on the criterion test. Results of the two-way analysis of variance indicated that there was no significant

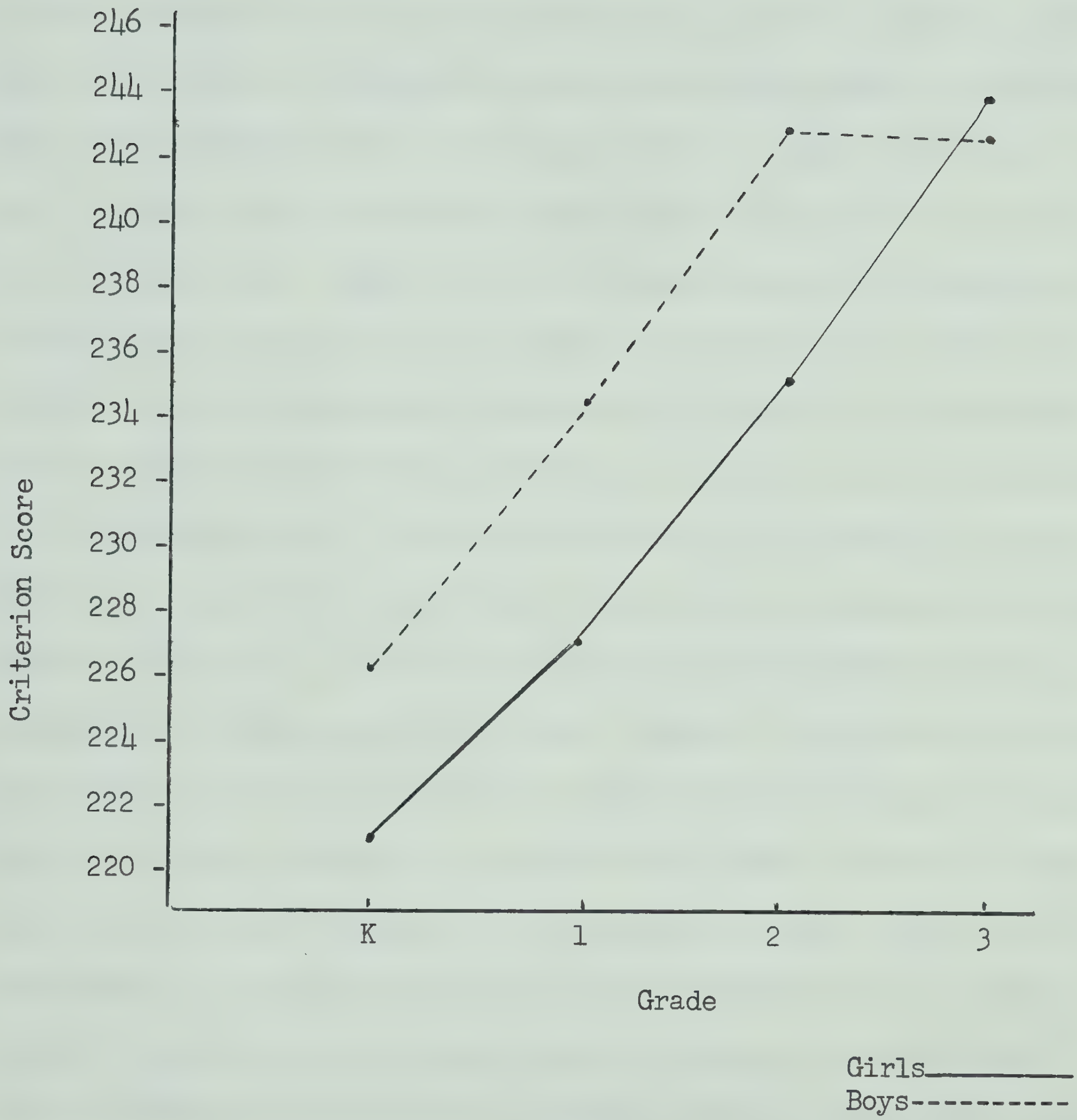

FIGURE 5

MEAN SCORES ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST BY GRADE AND SEX

interaction between grade and sex. Therefore, null hypothesis 2 (a) which stated that in analyzing auditory discrimination scores, there is no significant interaction between grade and sex was accepted. Although the mean scores of the boys in kindergarten, grade one and grade two were higher than those of the girls in the corresponding grades, at the grade three level the mean score of the girls was 1.70 higher than that of the boys. However, the interaction between grade and sex was not statistically significant. Results of the two-way analysis of variance also indicated that there was no significant main effect due to sex. The difference in the performance between boys and girls on the auditory discrimination test was not significant. Therefore, the null hypothesis 2 (b) which stated that, in analyzing auditory discrimination scores, there is no significant main effect due to sex, was accepted. The boys achieved higher than the girls on the auditory discrimination test in kindergarten, grade one and grade two. However, the difference in achievement between boys and girls was not statistically significant. At the grade three level, the girls' mean score was higher than that of the boys, but not significantly so. As indicated in Chapter III, the boys were superior in intelligence on both the language and non-language sections. However, at the grade three level where there was only a slight difference in the mean I.Q. of boys and girls, the latter achieved higher than the boys on the auditory discrimination test. The difference was not significant and therefore the analysis revealed no interaction.

Using a two-way analysis of variance the investigator also tested for interaction between socio-economic status and grade, and, main effect due to socio-economic status on the Fast-Cosens Auditory Discrimination Test scores.

Figure 6 depicts the mean scores by socio-economic status and grade.

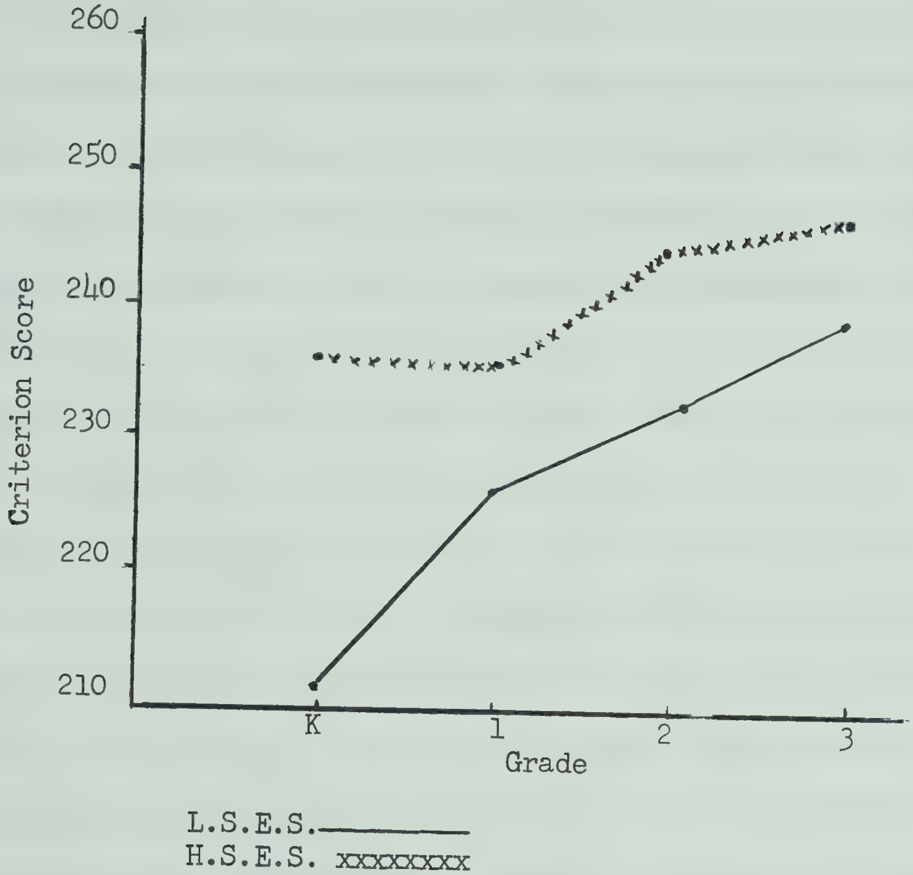

FIGURE 6

MEAN SCORES ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST BY GRADE AND S.E.S.

The difference between the means of the low and high socio-economic kindergarten groups was 25.70. At the grade one level, however, the difference between the low and high S.E.S. groups was only 10.55. The mean difference in grade two, when consideration was given to socio-economic status, increased to 13.35. At the grade three level the mean difference dropped to 8.70. Findings indicated that the interaction between socio-economic status and grade was statistically significant at the .05 level. Therefore null hypothesis 2 (c) which stated that in analyzing auditory discrimination scores, there is no significant interaction between grade and socio-economic status was rejected. Socio-economic status, when considered by itself was found to have a significant main effect at the .01 level. Although the high socio-economic groups tended to make higher scores than the low S.E.S. groups, the difference between their scores at the successive grade levels decreased, generally. In kindergarten, the mean scores for the low and high S.E.S. groups were 211.05 and 236.75 respectively. However, in grade one the mean auditory discrimination scores for the low and high S.E.S. groups were 226.00 and 236.65 respectively. The grade one mean score for the high socio-economic group is almost identical to that of the high S.E.S. kindergarten group. Therefore the difference in scores of 10.65 actually represents the gain between the kindergarten and grade one for the low S.E.S. group. However, in grade two the high S.E.S. pupils achieved better than the low S.E.S. children. At the grade three level the difference between the two socio-economic groups was less than in grade two. The findings suggest that educational opportunities tend to reduce the contribution of low socio-economic status, but socio-economic status as such, remains a significant variable in this study as it relates to pupil performance on the auditory

discrimination test. The high socio-economic groups consistently made better scores on the Fast-Cosens Auditory Discrimination Test than did the low socio-economic groups. Null hypothesis 2 (d) stated that, in analyzing the auditory discrimination scores, there is no significant main effect due to socio-economic status. Therefore, upon the basis of the findings in the present study, null hypothesis 2 (d) was rejected.

Summary

Results of the two-way analysis of variance indicated that interaction between grade and socio-economic status was significant at the .05 level. Furthermore, socio-economic status, by itself, was an important factor in determining success on the Fast-Cosens Auditory Discrimination Test. In this study, the findings indicated that the main effect due to socio-economic status decreased markedly after three years in school. Interaction between sex and grade, and, main effect due to sex failed to be statistically significant. There was no significant difference between girls and boys in performance on the auditory discrimination test.

CHAPTER VI

SUMMARY, CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

One of the important tasks in the reading process is the learning of phoneme-grapheme associations. This necessitates the ability to perceive minute differences in sounds and printed symbols. Auditory discrimination, as it relates to the child learning to read is generally regarded as the capacity to distinguish between phonemes or individual sounds in speech. The major purpose of this study, therefore, was to investigate the ability of children in kindergarten, grades one, two and three to discriminate between selected speech sounds. This study also attempted to determine whether there was a significant increase in auditory discrimination performance of children between four successive grade levels. This would lend support to the postulation that auditory discrimination is developmental. In addition to this, information was also sought regarding specific auditory discrimination difficulties with selected speech sounds which children experience at the various grade levels.

This chapter will present a brief summary of the study and outline the main findings. Conclusions will then be drawn from the findings. The educational implications and suggestions for further research arising out of these conclusions will be discussed.

I. SUMMARY AND MAIN FINDINGS OF THE STUDY

The test population consisted of all children attending kindergarten in the city of Edmonton, and all children enrolled in grades one, two and

three in the Edmonton Public School System. Twenty boys and twenty girls were randomly selected at each grade level thus yielding a total test sample of 160 subjects. The subjects were from two schools and two kindergartens designated by officials in consultation with the investigator. One school and one kindergarten were in an area designated as being of low socio-economic status, and, one school and one kindergarten were in an area designated as being in a high socio-economic status.

A socio-economic rating was obtained for each subject by combining the score from the Blishen (1968) Socio-Economic Index for Occupations and the score on a modified version of Elley's (1961) revision of the Gough Home Index Scale.

The auditory acuity of each subject was determined by an audiometric test, individually administered, using a Maico audiometer. Those subjects with auditory acuity losses of twenty-five decibels at two or more frequencies, or, thirty decibels or greater at any single frequency were eliminated from the study. Upon this basis, twenty subjects were excluded from the study and replaced by other randomly selected subjects who had no significant auditory acuity losses.

Intelligence test scores were determined for each pupil by administering the California Short-Form Test of Mental Maturity. Level o was used for the kindergarten subjects and Level 1 for all subjects in grades one, two and three.

Sex and chronological age for each subject in the test sample were taken from the cumulative records on file in the school.

Auditory discrimination was measured by the Fast-Cosens Auditory Discrimination Test. This test consists of 266 pairs of words. In 133 of the word-pairs, the two words are the same, that is, the words are

identical in sound. In the other 133 pairs of words there is a minimal difference of one sound between the two words. The subjects were required to indicate whether or not the word-pairs were the same or different. If the second word was exactly the same as the first word, the pupil kept his hands in his lap. If the words were different, that is, if the second word did not sound exactly like the first one, the pupil raised his hand. The subjects' responses were recorded by the investigator and two other (teacher) helpers on IBM answer sheets.

The data collected were processed by computer services at the University of Alberta. The statistical techniques employed were item analyses, one-way and two-way analyses of variance, and computations of correlations.

The findings with respect to each of the hypothesis are as follows:

Null Hypothesis 1

Among children in kindergarten, grades one, two and three, there are no significant differences in their ability to make auditory speech discriminations as indicated by their

a. total test scores on the Fast-Cosens Auditory Discrimination Test,

b. subtest scores on test items measuring the following sound type contrasts

    (1) stop-stop contrasts

    (2) nasal-nasal contrasts

    (3) semivowel-lateral contrasts

    (4) fricative-fricative contrasts

    (5) affricate-fricative contrasts

    (6) fricative-stop contrasts

    (7) semivowel-semivowel contrasts,

c. subtest scores on test items measuring voiced and voiceless sounds,

d. subtest scores on test items measuring sounds in the initial, medial, and final position, and

e. subtest scores on test items measuring like and unlike word-pairs.

Null Hypothesis 1(a). The mean grade scores of the Fast-Cosens Auditory Discrimination Test showed an increase in the ability of children at the successive grade levels to auditorially discriminate. The Scheffé Multiple Comparisons Test indicated that there was a significant difference between kindergarten and grade two, kindergarten and grade three, and, grade one and grade three. On the basis of these findings, Hypothesis 1(a) was rejected. Although the mean score of pupils in grade one was higher than that of the kindergarten group, and, the mean score of grade three pupils was higher than the mean score of grade two pupils, the difference between these grades was not statistically significant. The gradual increase in mean auditory discrimination scores between the successive grade levels achieved significance over a period of two grades. In this study, it would appear that the children's ability in auditory discrimination developed gradually from kindergarten through grades one, two and three.

Null Hypothesis 1(b). When consideration was given to specific sound type contrasts, findings indicated that there were significant differences between the grades. Therefore, Hypothesis 1(b) was rejected. The difference in auditory discrimination performance between kindergarten and grade one subjects was significant in only two specific sound type contrasts, namely, affricate-fricatives, and, semivowels.

The pupils' ability to make auditory discriminations between speech

sounds at the grade two level was significantly better than that of pupils in kindergarten, with the exception of affricate-fricative, and semivowel contrasts. This would indicate that for children in these grades, affricates, fricatives and semivowels are difficult sound types to discriminate.

When specific sound types were considered, the pupils in grade three performed significantly better than the kindergarten pupils at the .01 level of significance in discriminating between nasal, semivowel-lateral, fricative, and affricate-fricative sound contrasts. The most significant increase was in the discrimination of word-pairs involving fricative sound contrasts. At the .05 level of significance, the grade three pupils were superior to the kindergarten pupils in discriminating between stop and semivowel sound contrasts. The significant increases in mean scores between kindergarten and grade three lends further support to the finding that the ability to auditorially discriminate is a developmental process which matures as late as a child's eighth year. This is further substantiated by the smaller increase in mean scores between grade two and grade three which failed to be statistically significant.

Null Hypothesis 1(c). In discriminating voiceless sounds, there was a significant difference between kindergarten and grade one, kindergarten and grade two, and, kindergarten and grade three. When discrimination of voiced sounds was considered, the difference between kindergarten and grade two, kindergarten and grade three, and, grade one and grade three was significant at the .01 level. Therefore the null hypothesis 1(c) was rejected. As indicated by higher mean grade scores, voiceless sounds were more easily discriminated than voiced sounds.

Null Hypothesis 1(d). In auditory tasks involving discrimination

between initial, medial and final sounds, the mean scores of pupils in each of grade two and grade three were significantly higher than those of pupils in kindergarten. Therefore, null hypothesis 1(d) was rejected. In addition, discrimination of sounds in the medial position showed significant improvement between every grade level with the exception of kindergarten and grade one. The results of this investigation also showed that after one year in grade one, the children were significantly better in discriminating sounds in the final position. As was indicated in Chapter IV, the subjects in the test sample found sounds in the final position most difficult to discriminate and sounds in the medial position least difficult.

Null Hypothesis 1(e). When consideration was given to discriminating like word-pairs, the only significant difference was between kindergarten and grade three pupils. It would appear that auditory discrimination which involves detecting similarities of words was a relatively easy task for subjects in this study. However, as Vernon (1952) stated, perception involving discrimination of differences is a more difficult task. Pupils in grade two and grade three were significantly superior to those in kindergarten in discriminating the unlike word-pairs. Similarly, there was a significant difference at the .05 level between grade one and grade three on auditory discrimination tasks involving unlike word-pairs. Therefore, null hypothesis 1(e) was rejected.

Null Hypothesis 2

In analyzing auditory discrimination scores

a. there is no significant interaction between grade and sex,

b. no significant main effect due to sex,

c. no significant interaction between grade and socio-economic status, and

d. no significant main effect due to socio-economic status.

This hypothesis was analyzed using a two-way analysis of variance. Findings indicated that there was no significant difference between boys and girls on the total scores of the Fast-Cosens Auditory Discrimination Test. Although the boys made higher scores than the girls in kindergarten, grade one and grade two, in grade three the girls' mean score was higher than that of the boys. However, there was no significant interaction between grade and sex for the total test sample. Therefore, null hypotheses 2(a) and 2(b) were accepted.

Results of the investigation indicated that interaction between grade and socio-economic status was significant at the .05 level. Therefore null hypothesis 2(c) was rejected. The high socio-economic groups consistently made better scores than did the low socio-economic groups at every grade level. The greatest difference between scores occurred at the kindergarten level. However, by the end of grade three, the difference between the scores of the socio-economic groups had decreased markedly as compared to that of kindergarten. When considered by itself, socio-economic status was found to have a significant main effect, at the .01 level, on the auditory discrimination test scores of the total test sample. Therefore, hypothesis 2(d) was rejected.

Null Hypothesis 3

There is no significant correlation between ability to make auditory speech discriminations and

a. intelligence, and

b. chronological age in months.

When the total test sample was considered, intelligence was significantly correlated with pupils' performance on the auditory discrimination test at the .01 level. Pupils with higher intelligence performed better than the pupils with lower intelligence on the Fast-Cosens Auditory Discrimination Test. Therefore, null hypothesis 3(a) was rejected.

Chronological age was found to be significantly related to auditory discrimination ability at the .01 level when consideration was given to the total test sample. Generally, older subjects in the present study made higher auditory discrimination test scores than did the younger ones. Therefore, null hypothesis 3(b) was rejected.

Chronological age was found to be significantly related to auditory discrimination ability at the .01 level when consideration was given to the total test sample. Generally, older subjects in the present study made higher auditory discrimination test scores than did the younger ones. Therefore, null hypothesis 3(b) was rejected.

II. CONCLUSIONS

On the basis of the findings of this study, the following conclusions are drawn for this test sample:

1. Ability in auditory discrimination appears to be a developmental process from kindergarten to grade three inclusive as indicated by the gradual increase in mean auditory discrimination test scores at each successive grade level.
2. In showing increased ability in auditory discrimination during the primary grades, some groups of children can be expected to proceed

faster than others. Generally speaking, most groups will have acquired adequate auditory discriminative ability by the end of grade two or grade three.

3. Important factors in the development of auditory discrimination are the specific type of sound, voicing, and the particular position of sounds in words. Therefore, it may be concluded that children's ability to discriminate a sound will depend on the type of sound it is, whether it is voiced or voiceless, and its position in the word.
4. The auditory discrimination of unlike word-pairs is a more exacting task than the discrimination of like word-pairs.
5. Intelligence appears to be a good predictor of ability to make auditory discriminations in grades two and three. Children of higher intelligence tend to perform better than children of lower intelligence on auditory discrimination tasks.
6. Sex is not a good predictor of ability in auditory discrimination.
7. High socio-economic status appears to have a positive significant effect on the ability to auditorially discriminate.
8. Older children in the primary grades can be expected to manifest better auditory discriminative ability than younger children.
9. Teachers must be alerted to the developmental nature of auditory discrimination in young children and recognize its importance in the reading process.

III. IMPLICATIONS

A number of educational implications are evident from the findings and conclusions of this study.

1. Since it appears that auditory discrimination is a developmental

process vital to learning to read, therefore, as early as kindergarten or grade one, children's auditory discriminative ability should be carefully assessed and auditory training programs should be initiated. These auditory training programs should provide children with the opportunity to improve through regular, systematic, sequential instruction.

2. Teachers of reading should realize that certain sounds are more discriminable than others, making necessary programs designed to meet specific needs in auditory discrimination. Extended auditory perceptual training may be necessary in order to attain a level of competence required for success in reading during the primary grades.
3. Teachers require materials specific to programs designed to meet the auditory needs of children. In addition to this, they also need courses or suggestions as to how they can incorporate this kind of instruction into their regular reading programs.
4. Although there was no significant difference between performance of children in grade two and grade three on some types of sounds, the fact must not be overlooked that some children at these grade levels require auditory training in those sounds not mastered even though the group as a whole does not. The classroom teacher is therefore charged with the responsibility of providing the necessary auditory perception program for those children who continue to manifest deficiencies in auditory discrimination.
5. With the availability of listening centres in most schools, teachers should capitalize on reinforcing related taped activities such as listening for beginning and ending sounds, discriminating between word-pairs, and identifying words that rhyme as a means of increasing

children's ability in auditory discrimination.

6. Diagnostic instruments in auditory discrimination need to be devised for teachers that will enable them to identify those sounds not yet mastered by pupils at various grade levels.
7. In view of the findings of this study, it would seem that children from low socio-economic areas require additional auditory perceptual training programs when they enter school. In addition to this, teachers should provide increased opportunities for the development of oral language as an integral part of the reading program. Closely related to auditory perception is the ability to pronounce all common speech sounds clearly and accurately.
8. As a result of this and other investigations involving auditory perception, the extreme necessity of audiometric testing, before or when children enter grade one, is underlined. Twenty subjects were excluded from the present study on the basis of inadequate auditory acuity. One may assume that there are many children in the primary grades experiencing difficulty with reading who have a hearing loss which remains undetected by the classroom teacher. Educators should combine efforts to bring this need to the attention of the proper authorities.
9. These implications should be noted by teacher education institutions so that appropriate adjustments in instruction can be made.

IV. SUGGESTIONS FOR FURTHER RESEARCH

As a result of this investigation, the following suggestions might be valuable in planning further research in this area:

1. A longitudinal study of a group of children should be initiated at

the kindergarten level and continued through the primary grades. A test sample large enough to assure the maintenance of an adequate number of pupils at the termination of the study in grade three is essential. In this way, the same subjects could be followed over a number of years. Only by such a procedure can the hypothesis that auditory discrimination is developmental be truly substantiated.

2. A study should be made to determine the extent to which improvement in auditory discrimination is possible. This study should involve the same children as they advance from kindergarten to grades one, two and three.

3. As a result of findings in the present study, it has been possible to determine progress between the various grade levels. A further study should attempt to assess more extensively auditory discrimination ability of children within the grade groupings.

4. In addition to types of sounds, voicing, and position of sound, phonemic environment, as it relates to auditory discrimination, should be investigated. It would seem to be an extremely significant factor in the ability to auditorially discriminate. Findings indicated that fricatives were both the least and most difficult sound type contrasts for the subjects to discriminate, suggesting that phonemic environment must be investigated.

5. A further study which would investigate the relationship between socio-economic status and other areas of language should be undertaken in order to determine how auditory discrimination ability affects children's language development.

6. A similar investigation using a typical population representative of all socio-economic levels should be made to determine the development

of auditory discrimination as it relates to socio-economic status.

7. A study which would devise an auditory discrimination test acceptable for use with a group of children should be undertaken. Such an instrument would make it possible for the regular classroom teacher to assess the auditory discriminative ability of her pupils with an economy of time.

8. Research is needed to investigate the possibility that auditory acuity is developmental, and, the interrelationships between the possible developmental aspects of auditory acuity and the developmental aspects of auditory discrimination.

9. A study which would investigate the relationship between articulation and auditory skills in young children should be undertaken in order to determine whether the sounds children find difficult to discriminate are those they have difficulty articulating.

V. CONCLUDING STATEMENT

The purpose of this study was to investigate the ability of children in kindergarten, grades one, two and three to discriminate between selected speech sounds. This study also attempted to determine whether there was a significant increase in the auditory discrimination performance of the pupils from one grade to the next.

The findings of the present study indicated that there was an increase in the mean grade scores on the auditory discrimination test at each successive grade level. Although the mean score of pupils in grade one was higher than that of the kindergarten pupils, and, the mean score of grade three pupils was higher than that of grade two pupils, the differences were not statistically significant. However, the gradual increase in mean

auditory discrimination scores between the successive grade levels, which achieves significance over a period of two grade levels, lends support to the postulation that auditory discrimination is a developmental process. It would appear that children improve in the ability to auditorially discriminate from kindergarten through grades one, two and three.

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APPENDICES

APPENDIX A

LETTER TO PARENTS AND <u>HOME INDEX QUESTIONNAIRE</u>

Dear Parents:

I am a graduate student at the University of Alberta doing research in the field of Reading. It is hoped that the results of this research will help to improve school reading programs. I will be visiting the classroom that your child attends to observe specific skills related to the reading process.

Information about family background of the children is an important part of this research. It would be helpful if you would complete the attached questionnaire and return it in the enclosed envelope to your child's teacher within the next few days.

I realize that some of the questions are of a personal nature, but any alterations would invalidate the research. You need not sign the questionnaire and all information will be kept completely confidential. If you object to answering the questions, please return the blank questionnaire in the envelope to your child's teacher.

Thank you for your cooperation.

Yours sincerely,

Alaire G. Oberg

ALAIRE G. OBERG.

AGO/lc
Encl:

DIRECTIONS: In the following questions, draw a circle around the correct answer. For example, in the question "Does your family own more than one car?" draw a circle around the "YES" if your family does own more than one car, and around the "NO" if it does not. Be sure to answer all questions.

1. Does your family own more than one car?........................Yes No

2. Does your family have a garage or carport?....................Yes No

3. Did the father of this family go to high school?..............Yes No

4. Did the mother of this family go to high school?..............Yes No

5. Did the father of this family go to university?...............Yes No

6. Did the mother of this family go to university?...............Yes No

7. Is there a desk in your home?.................................Yes No

8. Do you have a combination stereo unit in your home?...........Yes No

9. Is there a piano or an electric organ in your home?...........Yes No

10. Is there a color TV in your home?............................Yes No

11. Does your family get a daily newspaper?......................Yes No

12. Does the child who brought this home have his (her) own room at home?...Yes No

13. Do you own your home?..Yes No

14. Is there an encyclopedia in your home?.......................Yes No

15. Are there more than 100 books in your home?..................Yes No
(eg: 4 shelves: 3 feet long)

16. Does either parent in this home make regular use of the Library?..Yes No

17. Do you subscribe to one or more of the following magazines?...Yes No
    A. Time   B. Newsweek   C. Saturday Night
    D. Macleans   E. Reader's Digest

18. Does your family leave town each year for a holiday?..........Yes No

19. Do you belong to any club where you have to pay fees?.........Yes No

20. Does the mother of this family belong to any clubs or organizations such as study, church, art or social clubs?.....Yes No

21. Does the father of this family belong to any such clubs or organizations?...Yes No

22. Has the child who brought this home ever had lessons in music, dancing, art, swimming, etc. outside of school?..............Yes No

APPENDIX B

ADMINISTRATION OF THE FAST-COSENS AUDITORY DISCRIMINATION TEST

FAST-COSENS AUDITORY DISCRIMINATION TEST

Practice Items

1. wide ride
2. thimble thimble
3. zip gyp
4. fell fell
5. nice knife
6. paint faint

Practice Items on Tape

1. rack rat
2. bag bag
3. cup cut
4. wide wide
5. slimmer slinger
6. lung rung

ADMINISTRATION OF THE <u>FAST-COSENS AUDITORY DISCRIMINATION TEST</u>

(Fast, 1968:175-183)

1. Each child was tested individually.
2. Each child faced the experimenter.

Following are the directions for administering the test.

Today we are going to play a game with words. In order to play this game, I will give you two words at a time, and you are to tell me if the words are the same or different. If I say the word twice, that is, if the second word is exactly the same as the first word, I want you to keep your hands on your lap - like this, (demonstrate for the child). If the words are different, that is, if you hear a change and the second word does not sound exactly like the first one, put your hand up - like this, (demonstrate for the child). Sometimes the words will rhyme, but they are not exactly the same.

Listen! I will give you two words and you are to tell me if they are the same or different, "wide", "ride". Are those the same or are they different? Show me! Yes, you are right, - the two words are different, so you lift up your hand.

Now let us try a few word pairs for practice, to make sure that you know how to play the game. (Give the examinee the practice items in Appendix A, Part II).

If after the practice items, a child still had trouble understanding the directions or the concept of 'same' and 'difference', additional practice items were given.

If the examinee understood the task, the test was ready to proceed.

I am going to switch on the tape recorder and see if you can play this game by listening to the words on the tape. Remember, if the words

[illegible]

sound the same, you keep your hands on your lap. If the words sound different, you put your hand up high. All right! Are you ready? Listen carefully! Two word-pairs were then played on the tape, "rack - rat, and bag - bag." The children were then asked to respond to these two word-pairs. If no difficulty was observed by the investigator, the test was ready to proceed.

The tape was again started, and the next four word-pairs (the rest of the practice items) were voiced on the tape, but not recorded by the investigator. This was to permit the examinee to get used to the rate and the intervals between word-pairs as presented on the tape recording.

Appendix A, Part II consists of the Test items which were presented to each student.

THE FAST-COSENS AUDITORY DISCRIMINATION TEST

1. witch wish
2. cap cap
3. bug bug
4. pleasure pledger
5. chin chin
6. seed seed
7. ring wing
8. first thirst
9. volt bolt
10. harsh harsh
11. shake shake
12. sheep cheap
13. reshine reshing
14. sink sink
15. lease leash
16. gaze gaze
17. red red
18. hash hatch
19. wed wed
20. dare dare
21. sheet sheet
22. pie thigh
23. raging raging
24. peeve peeve
25. slim sling
26. brimming brimming
27. nice nice
28. leap weep
29. breed breathe
30. wife wife
31. bad bag
32. thatch thatch
33. shape shape
34. had has
35. region reason
36. mess mess
37. cherry sherry
38. lath lash
39. by by
40. thine vine
41. tenth tenth
42. switches swishes
43. wishing wishing
44. chains change
45. swimming swinging
46. swim swim
47. elect erect
48. led led
49. boat boat
50. robe rode
51. clove clove
52. rocking rotting

53. van van
54. rash wrath
55. lap lap
56. muscle muffle
57. shack sack
58. range range
59. card card
60. lathe laid
61. shin shin
62. bathe bathe
63. then then
64. lath lass
65. day they
66. lit lit
67. way lay
68. legion legion
69. lash latch
70. by thy
71. cup cup
72. teething teething
73. bid bid
74. lesion legion
75. laid laid
76. simmer simmer
77. fought thought
78. ban van
79. wrath wrath
80. lass lash
81. sack sack
82. fearing feeling
83. roughing roughing
84. thought thought
85. thin thin
86. mesh mess
87. lap rap
88. rub rub
89. rap wrath
90. day day
91. popping potting
92. sherry sherry
93. thatch patch
94. ring ring
95. reason reason
96. has has
97. pick thick
98. grease grease
99. muff muff
100. ran rang
101. pie pie
102. peep peep
103. raising raging
104. push push
105. cheat sheet
106. bat bat

107. lit lick
108. leap leap
109. thy vie
110. cashing cashing
111. rains range
112. brimming bringing
113. slim slim
114. cad cad
115. clove clothe
116. waking waiting
117. vow vow
118. hearth harsh
119. rate rate
120. shake sake
121. page page
122. had had
123. bathe bade
124. thy thy
125. tenth tense
126. sing sing
127. dare there
128. lot lot
129. wait late
130. elect elect
131. pleasure pleasure
132. sinner sinner
133. mush muff
134. bath bath
135. shief thief
136. muss muff
137. cad cab
138. pushy pushy
139. cashing catching
140. reep reep
141. feeling feeling
142. grief grease
143. thorn thorn
144. waking waking
145. winning winging
146. popping popping
147. roughing rushing
148. clang clang
149. page pays
150. rate late
151. sun sung
152. thy thy
153. bail vale
154. rub rug
155. half hash
156 raft raft
157. fence thence
158. rung rum
159. cuffing cuffing
160. beater beaker

161. lot lock
162. peak peep
163. wing wing
164. naval naval
165 arriving arising
166. thy die
167. has have
168. lasses lashes
169. thigh thigh
170. fought fought
171. cog cob
172. hopper hotter
173. crutches crutches
174. bat that
175. pass pass
176. big bid
177. singer simmer
178. chat chap
179. lathe lave
180. dish dish
181. after aster
182. vow thou
183. sought thought
184. buzz buzz
185. wag rag
186. lashing laughing
187. closing clothing
188. late late
189. lens lend
190. lash lash
191. rising rising
192. wins wins
193. thank shank
194. rig rig
195. sheep sheath
196. latch latch
197. pup puff
198. winging winging
199. aster aster
200. witches wishes
201. web wed
202. lease lease
203. coke cope
204. puff puff
205. shoot shoot
206. laugh lash
207. sheep sheep
208. closing closing
209. leaf lease
210. thief thief
211. hash hash
212. beaker beaker
213. sinner singer
214. upper upper

215. refine reshine
216. swinging swinging
217. thin thin
218. gaze gave
219. lashing lashing
220. red led
221. win wing
222. rug tub
223. lasses lasses
224. clam clang
225. muffle muffle
226. lake late
227. shape shake
228. rack rack
229. thimble symbol
230. sung sung
231. arising arising
232. naval nasal
233. shot shop
234. peeve pease
235. hotter hotter
236. pussy pushy
237. first first
238. thence thence
239. bolt bolt
240. slitting slipping
241. switches switches
242. chat chat
243. thee be
244. mouse mouse
245. led leg
246. laugh laugh
247. rotting rotting
248. vale vale
249. sift shift
250. cap cat
251. lathe lathe
252. cuffing cussing
253. there there
254. sink think
255. raft waft
256. rising writhing
257. wind wins
258. wag wag
259. teething teasing
260. shin thin
261. cog cog
262. wreath reap
263. soak soak
264. wish wish
265. leap leaf
266. pass path

APPENDIX C

CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

LEVEL 0 AND LEVEL 1

1963 S-FORM LEVEL 0

CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

DEVISED BY ELIZABETH T. SULLIVAN, WILLIS W. CLARK, AND ERNEST W. TIEGS

TO THE TEACHER:

Before permitting the children to open their booklets, see that each child's name, age, school, and other information are filled in on the back cover. Encourage the children to do as many items in the test as they can.

12TH PRINTING

PUBLISHED BY CALIFORNIA TEST BUREAU/A DIVISION OF McGRAW-HILL BOOK COMPANY, DEL MONTE RESEARCH PARK, MONTEREY, CALIFORNIA —

TEST 1

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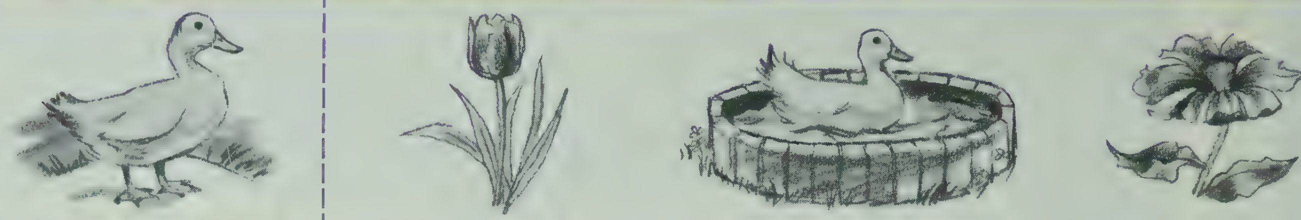

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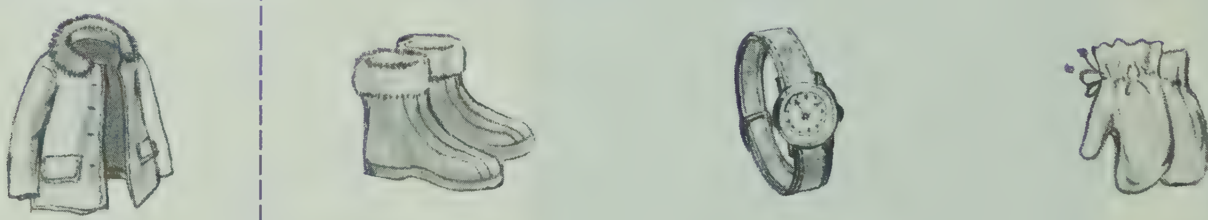

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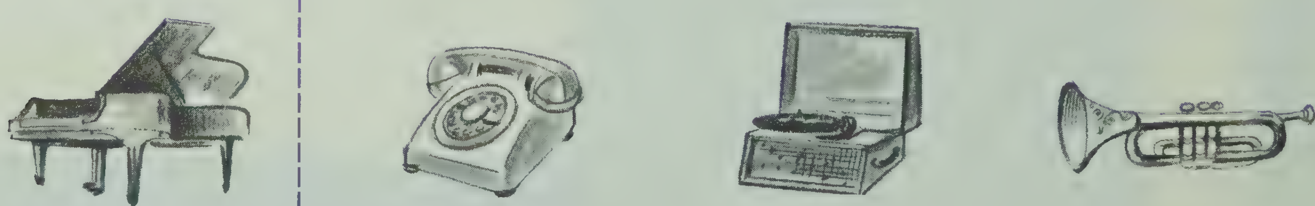

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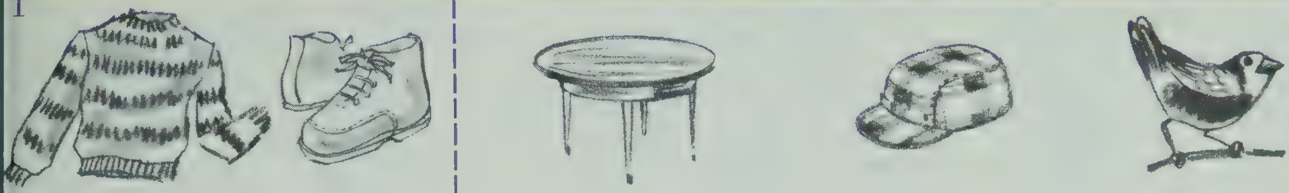

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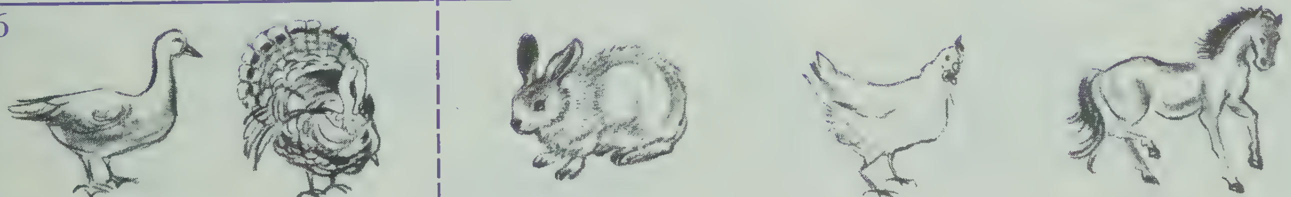

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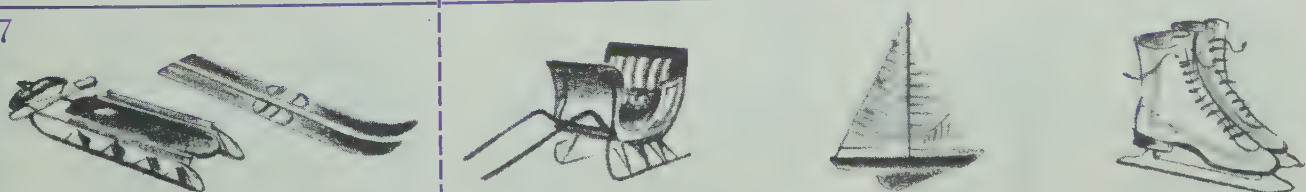

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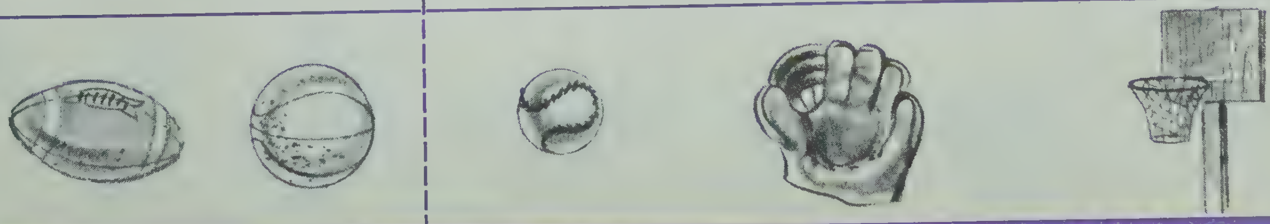

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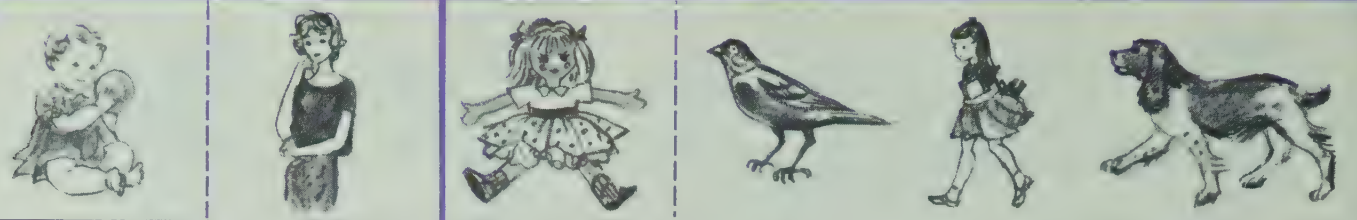

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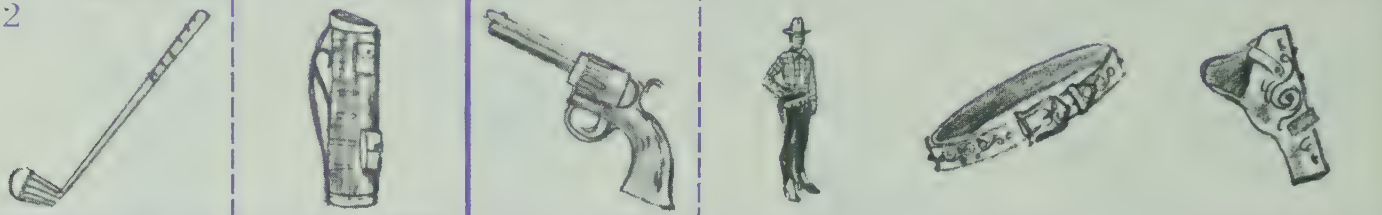

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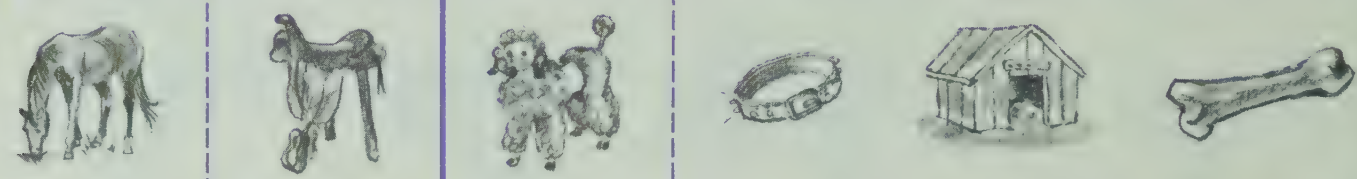

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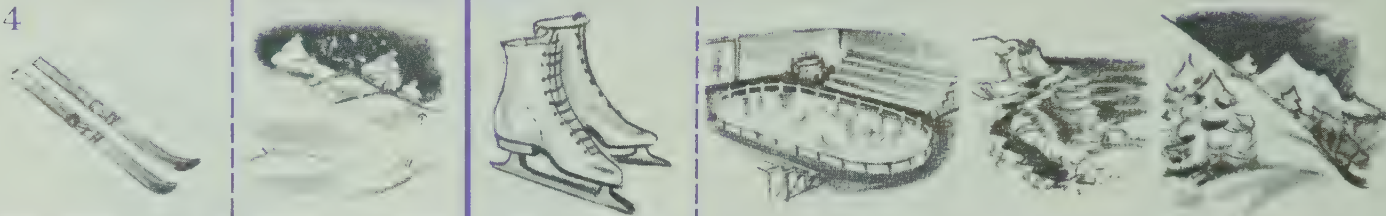

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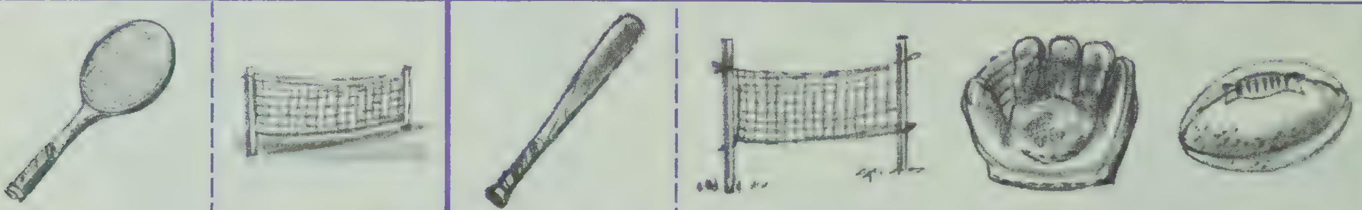

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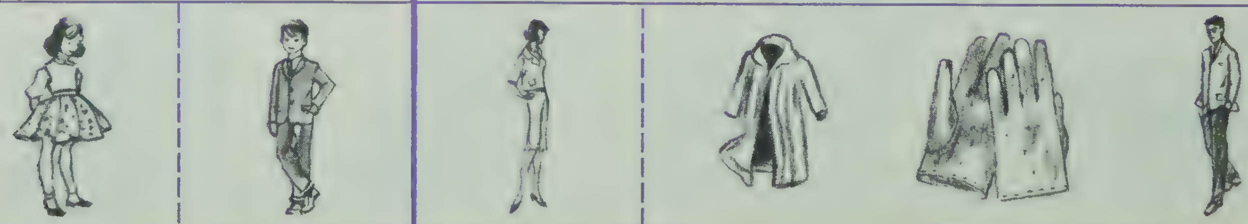

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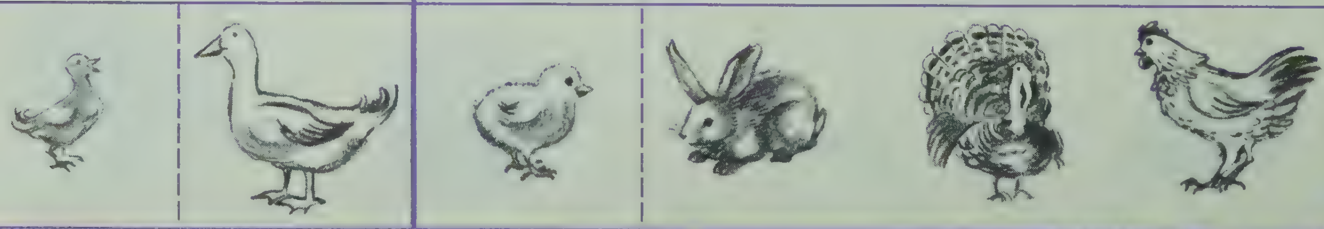

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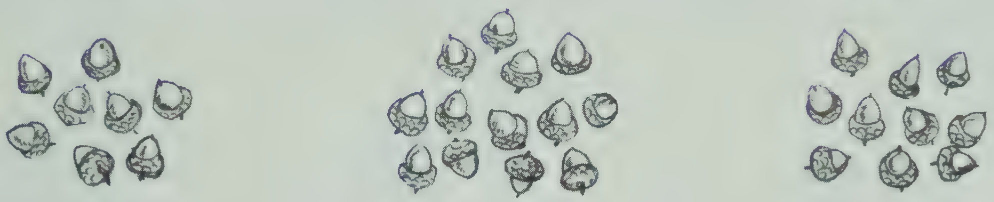

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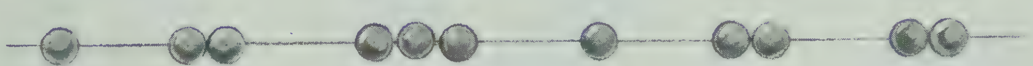

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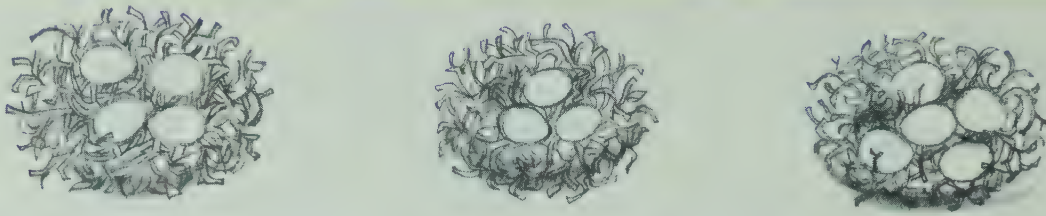

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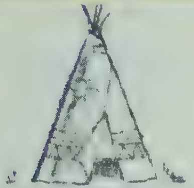
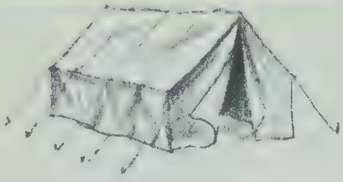


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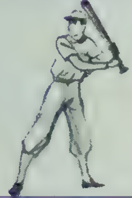

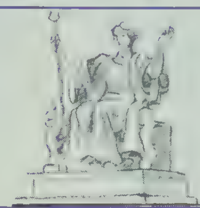

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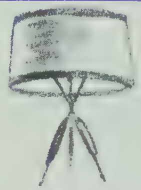

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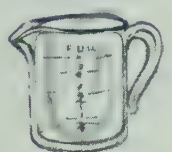
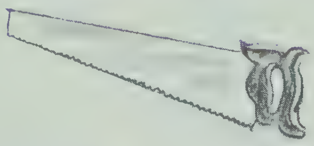
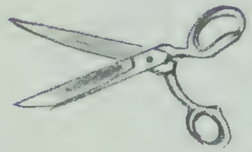

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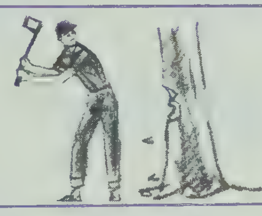
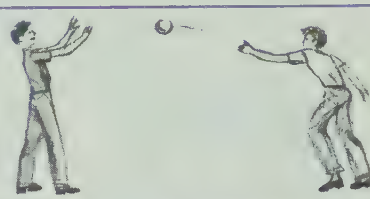

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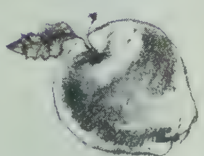

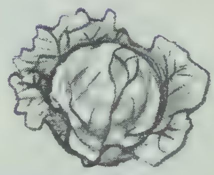

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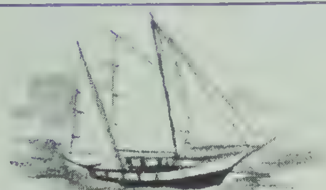
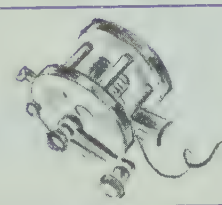


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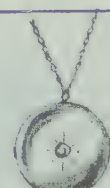

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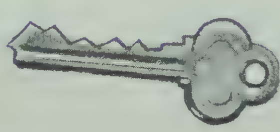
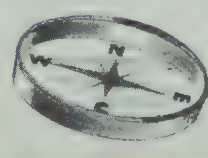

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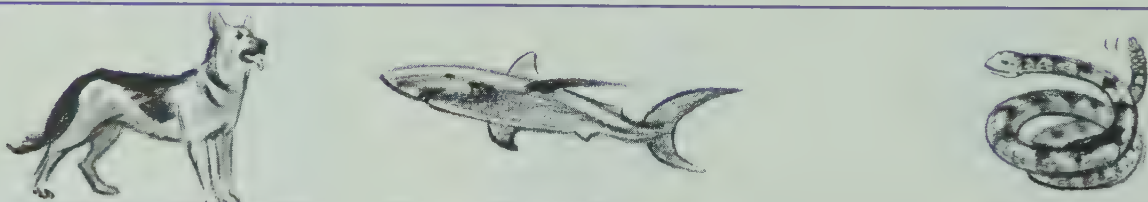

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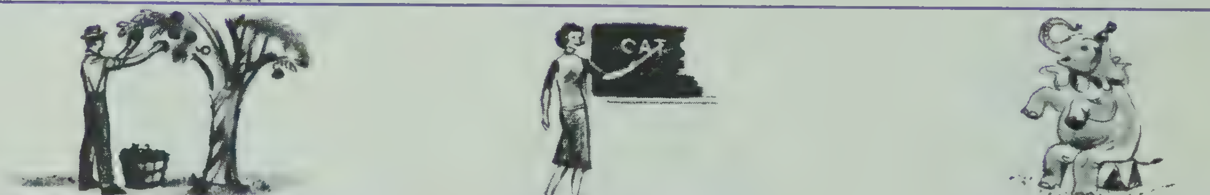

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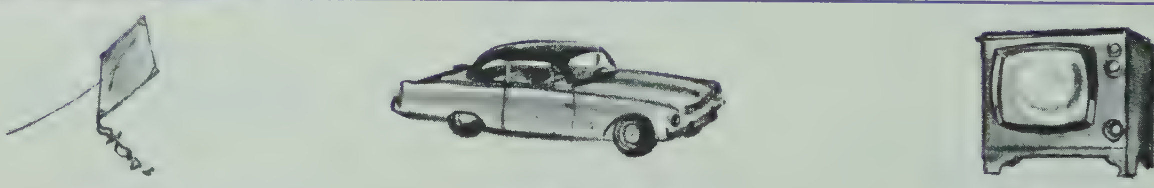

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TEST 6 SCORE (number right)

TEST 7

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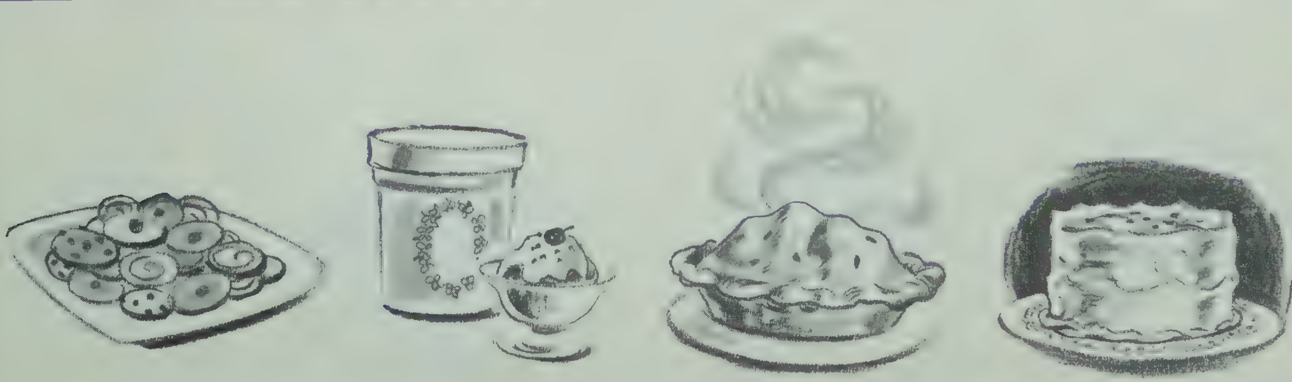

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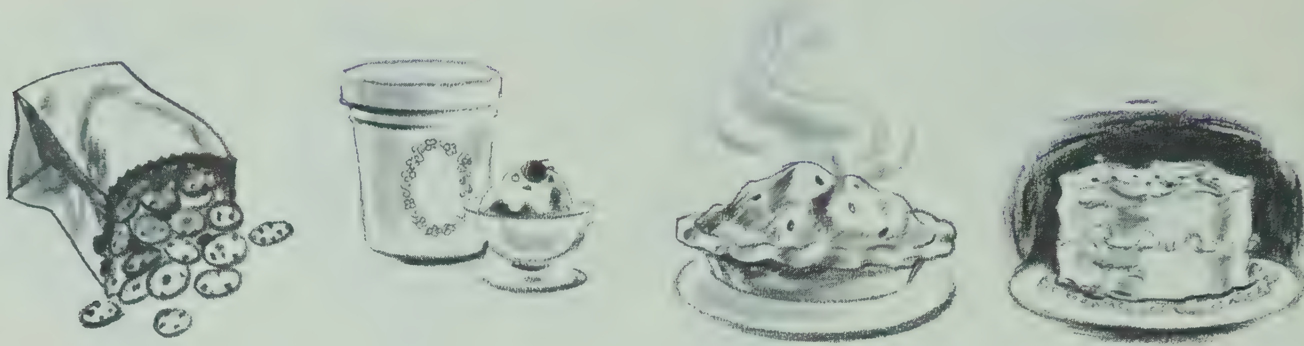

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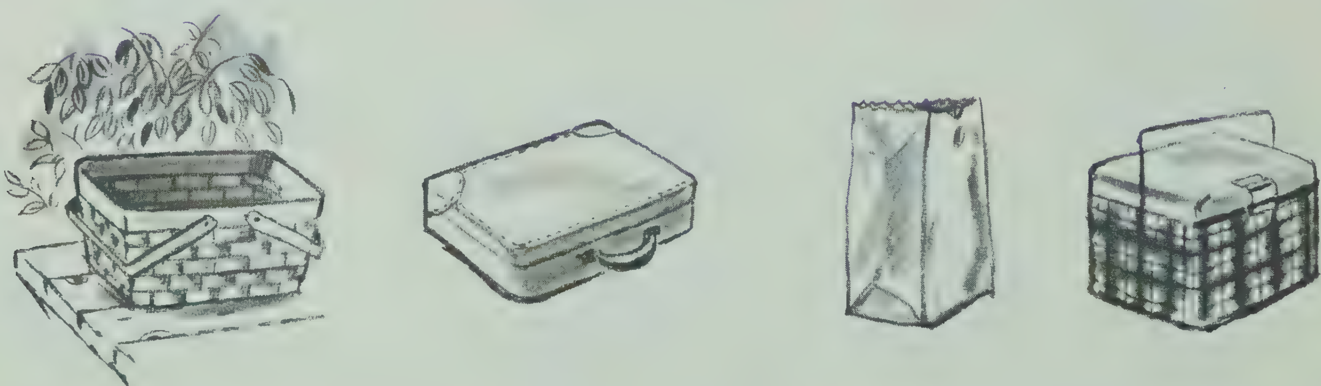

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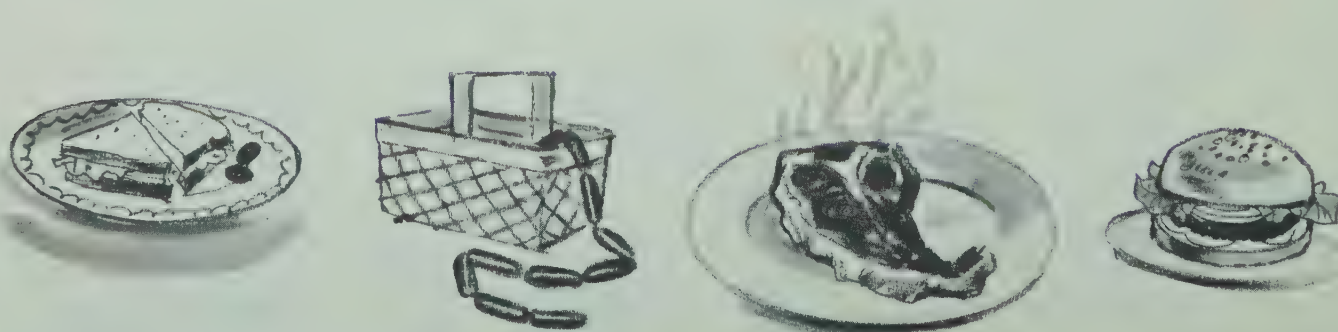


TEST 7 SCORE
(number right) . . .

CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

1963 S-FORM/LEVEL 0

DEVISED BY E. T. SULLIVAN, W. W. CLARK, AND E. W. TIEGS

Name.. (Last) (First) (Middle)

School.. City..

Boy Girl (Circle one) Grade.................... Teacher or Examiner...

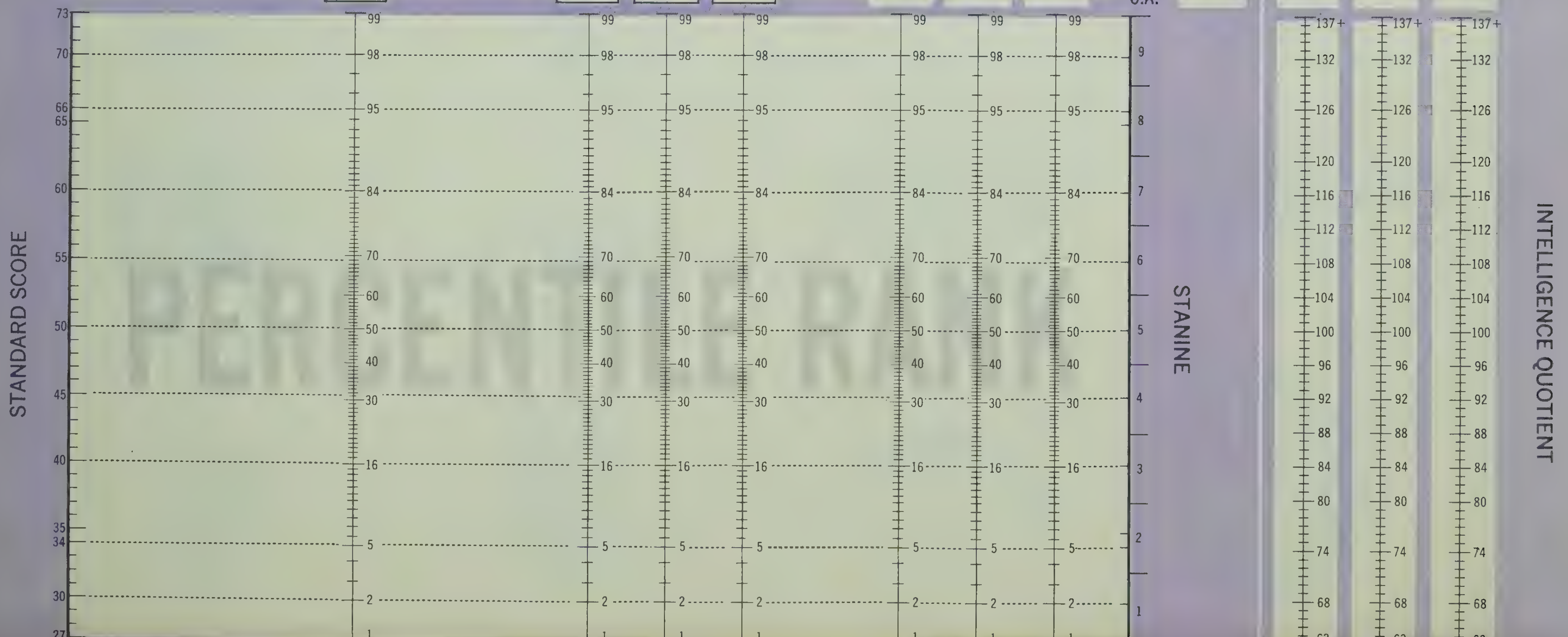
Date of Test............................ (Year) (Month) (Day)

Date of Birth............................ (Year) (Month) (Day)

C.A. .... (Years) (Months) ( ) (Total Mos.)

TEST/FACTOR	1. OPPOSITES	2. SIMILARITIES	3. ANALOGIES	I. LOGICAL REASONING	4. NUMERICAL VALUES	5. NUMBER PROBLEMS	II. NUMERICAL REASONING	III. VERBAL CONCEPTS (6. VERBAL COMPREHENSION)	IV. MEMORY (7. DELAYED RECALL)	LANGUAGE (Tests 5, 6, 7)	NON-LANGUAGE (Tests, 1, 2, 3, 4)	TOTAL	I.S.I.†
POSSIBLE SCORE	7	8	8	23	8	7	15	18	8	33	31	64	
RAW SCORE													ACTUAL G.P.
PERCENTILE*													GRADE C.A.

	LANGUAGE	NON-LANGUAGE	TOTAL
M.A.‡			
RAW SCORE			
I.Q.‡			



*Unless otherwise indicated, national norms appropriate for pupil's chronological age are used.

†Intellectual Status Index; see Manual.

‡Must be obtained from table in Manual.

1963 S-FORM LEVEL 1

CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

DEVISED BY ELIZABETH T. SULLIVAN, WILLIS W. CLARK, AND ERNEST W. TIEGS

TO BOYS AND GIRLS:

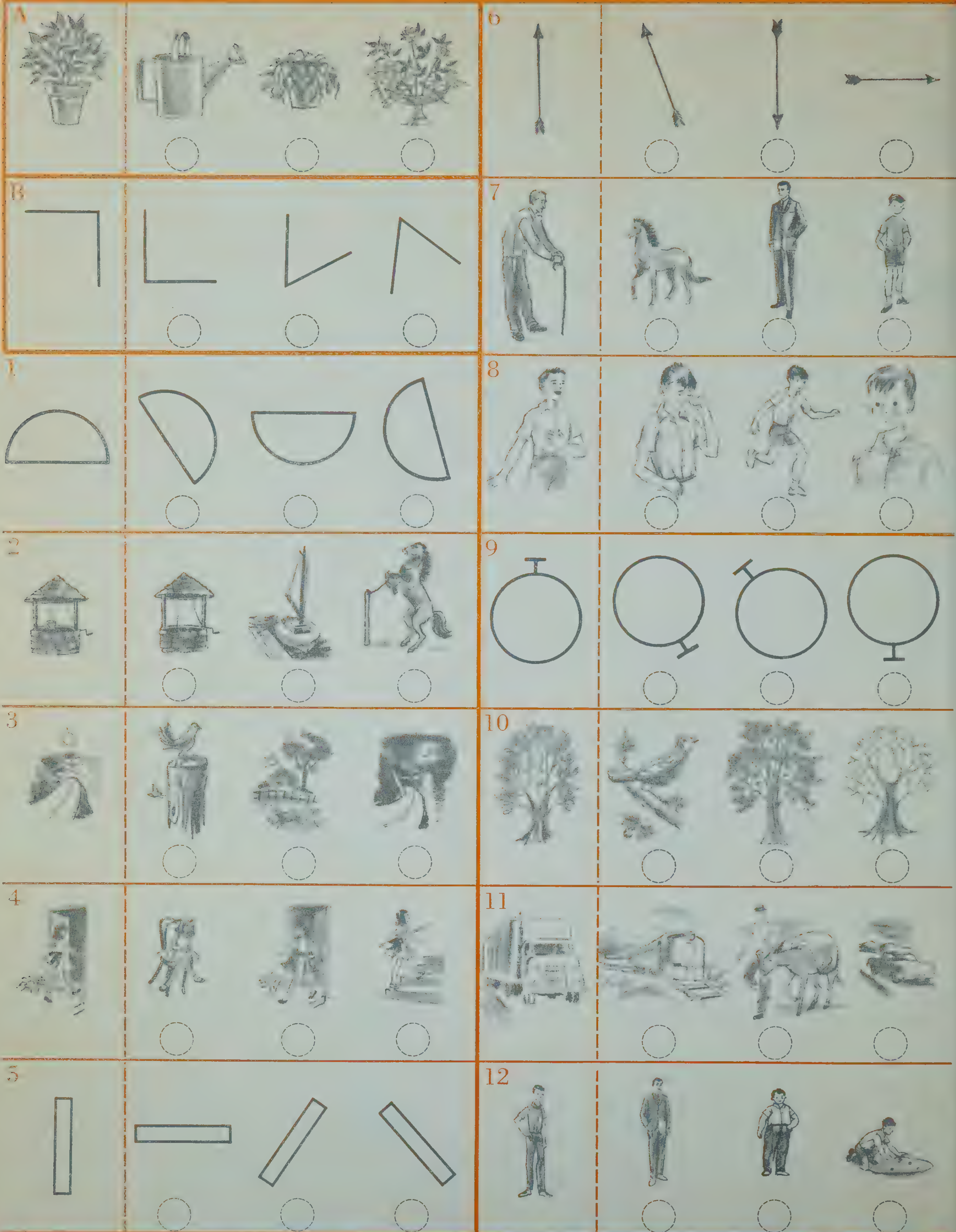
This booklet has some games you will enjoy. Each game will show how well you can think. Do as much as you can in each game.

Do not turn this page until told to do so.

14TH PRINTING

PUBLISHED BY CALIFORNIA TEST BUREAU/A DIVISION OF McGRAW-HILL BOOK COMPANY, DEL MONTE RESEARCH PARK, MONTEREY, CALIFORNIA

TEST 1



TEST 1 SCORE (number right)

TEST 2

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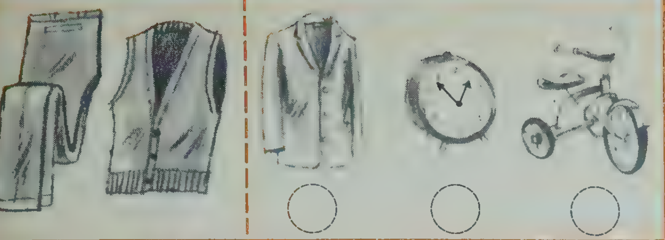

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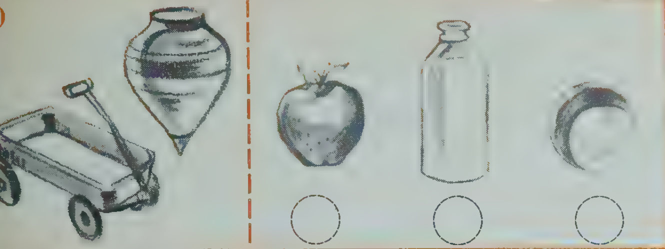

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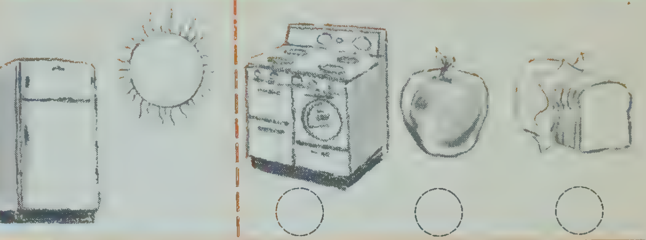

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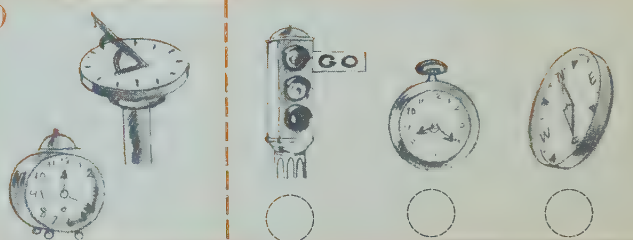

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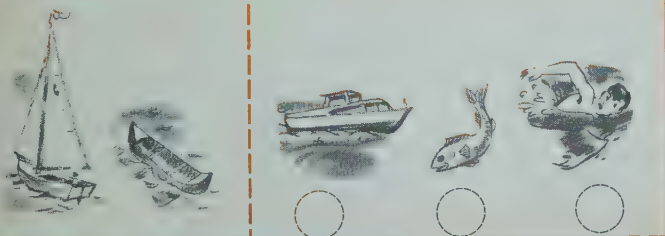

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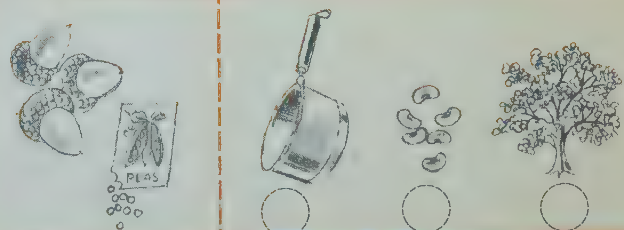

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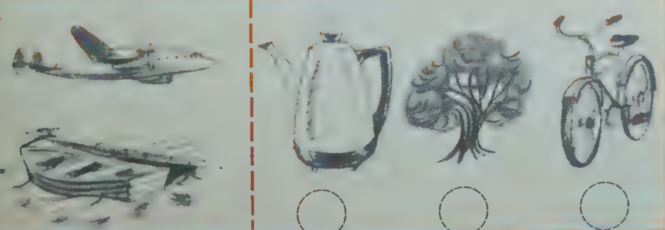

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TEST 2 SCORE
(number right) . . .

TEST 3

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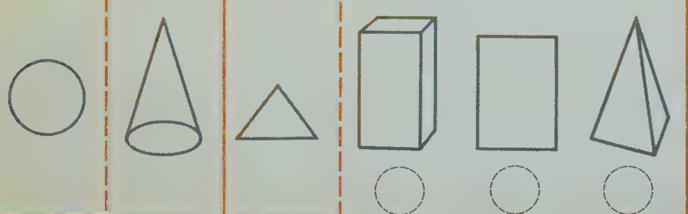

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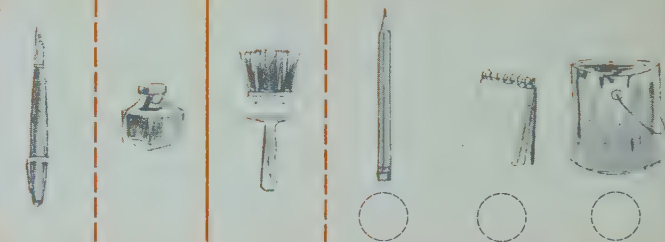

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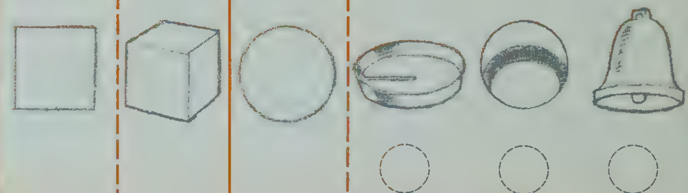

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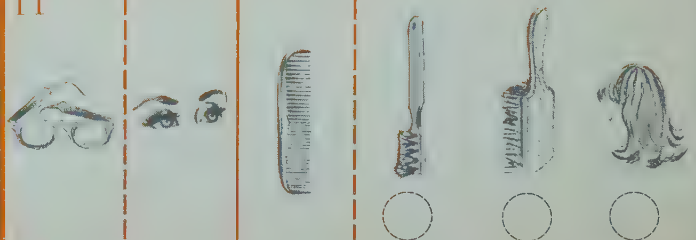

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TEST 3 SCORE (number right) . .

TEST 4

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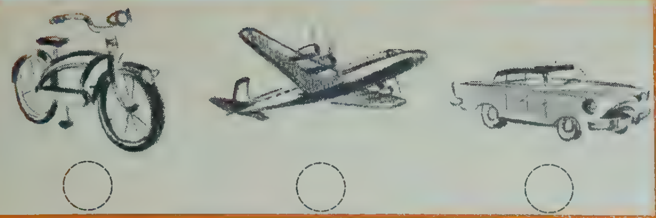

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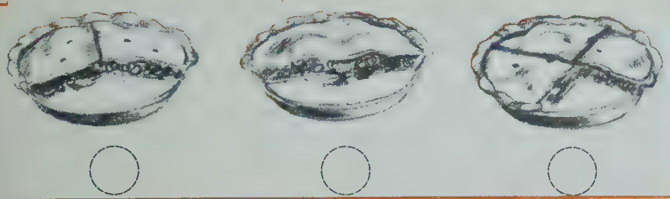

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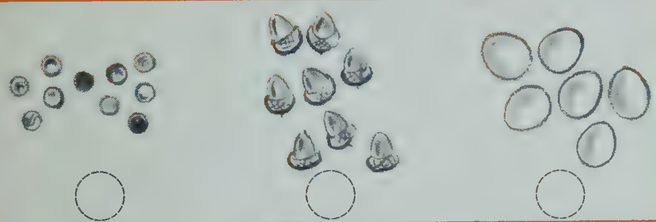

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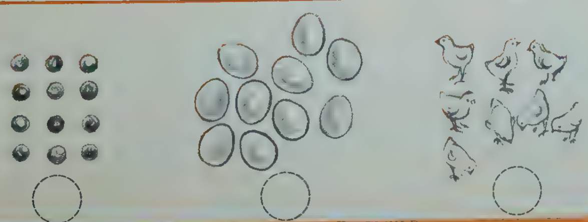

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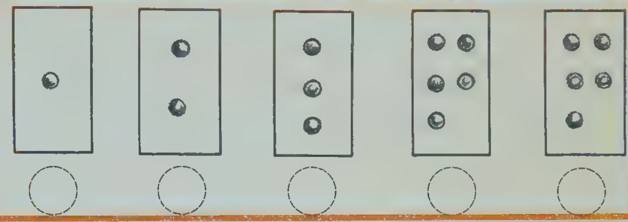

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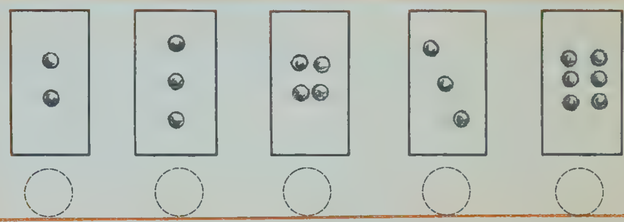

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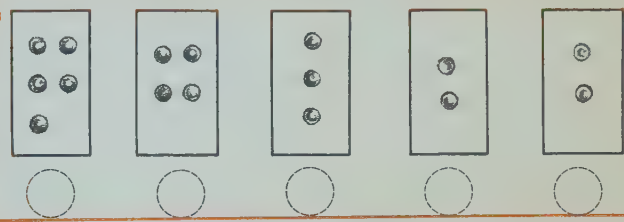

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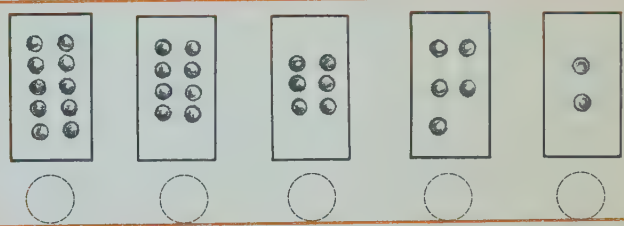

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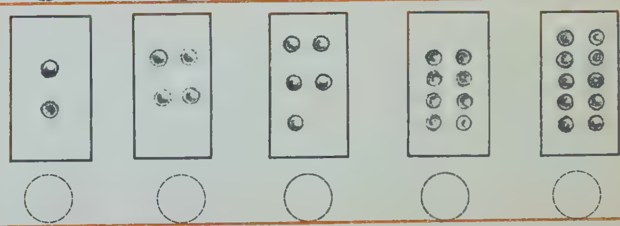

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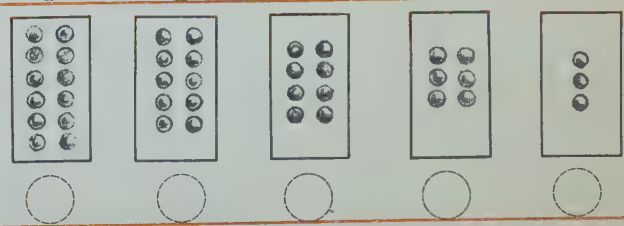

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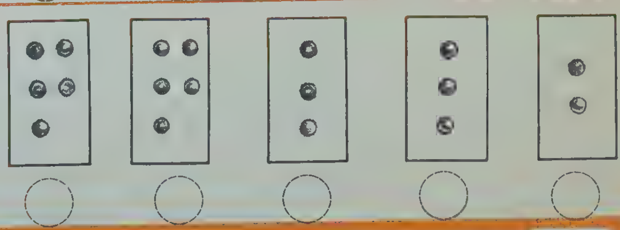

TEST 4 SCORE (number right)

TEST 5

TEST 5 SCORE
(number right) . .

TEST 6

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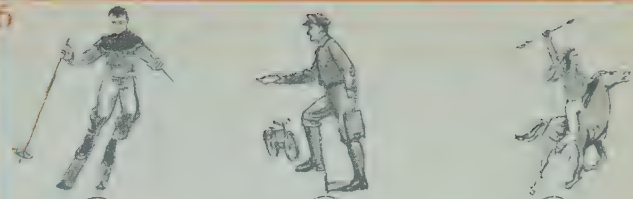

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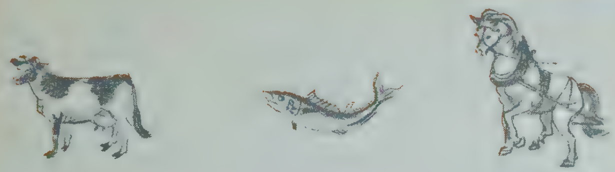

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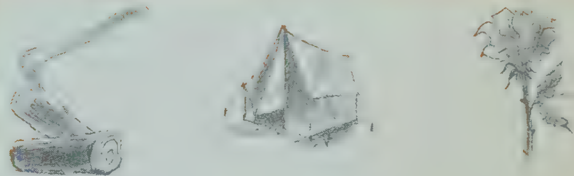

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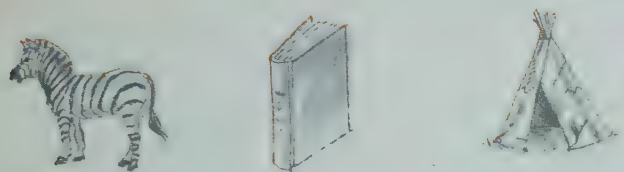

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TEST 6 SCORE
(number right)

TEST 7

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  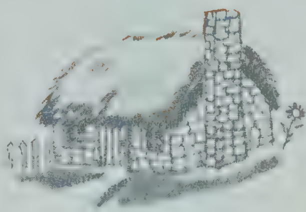 

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  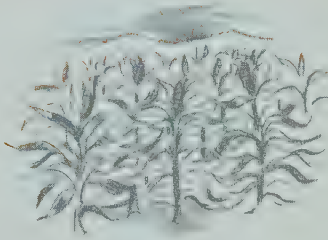 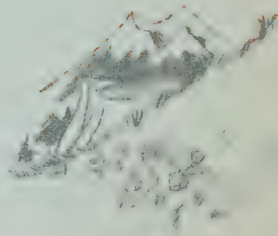

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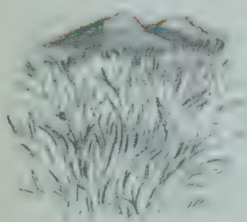   

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  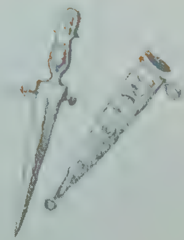 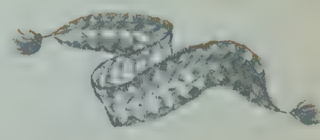

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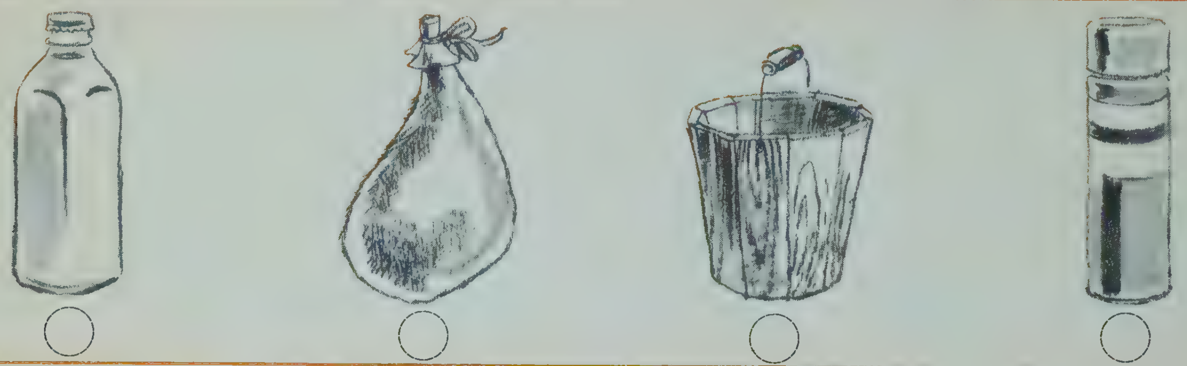

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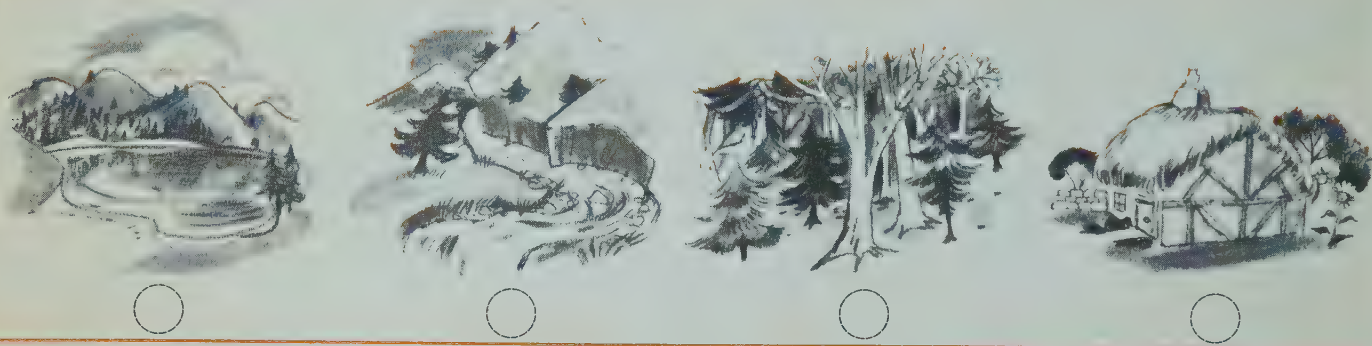

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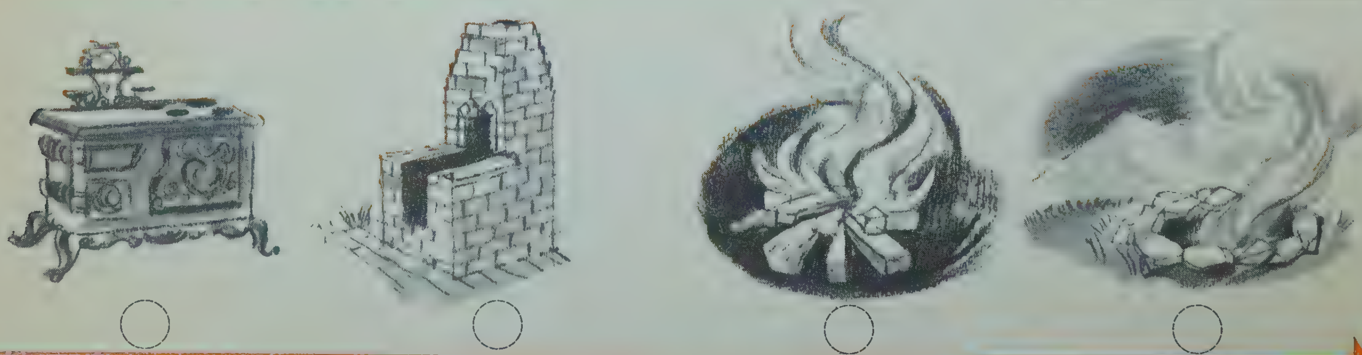

TEST 7 (Continued)

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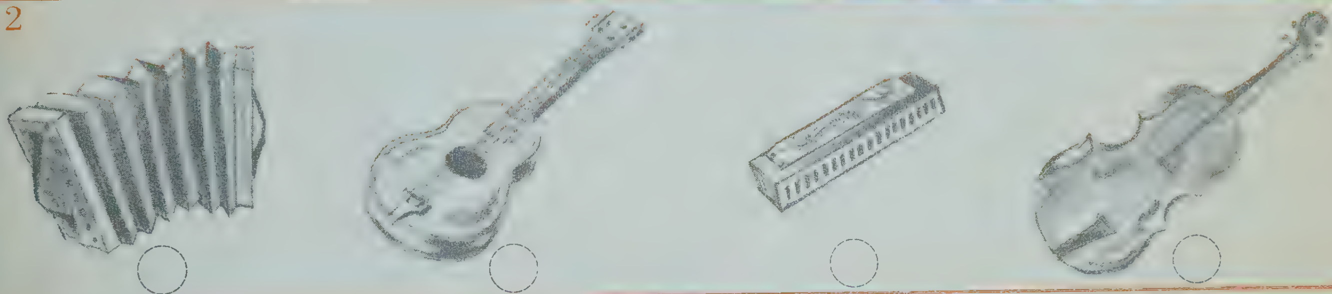

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TEST 7 SCORE
(number right)

CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

1963 S-FORM / LEVEL 1

DEVISED BY E. T. SULLIVAN, W. W. CLARK, AND E. W. TIEGS

Name .... (Last) (First) (Middle)

School .... City ....

Boy Girl (Circle one) Grade .... Teacher or Examiner ....

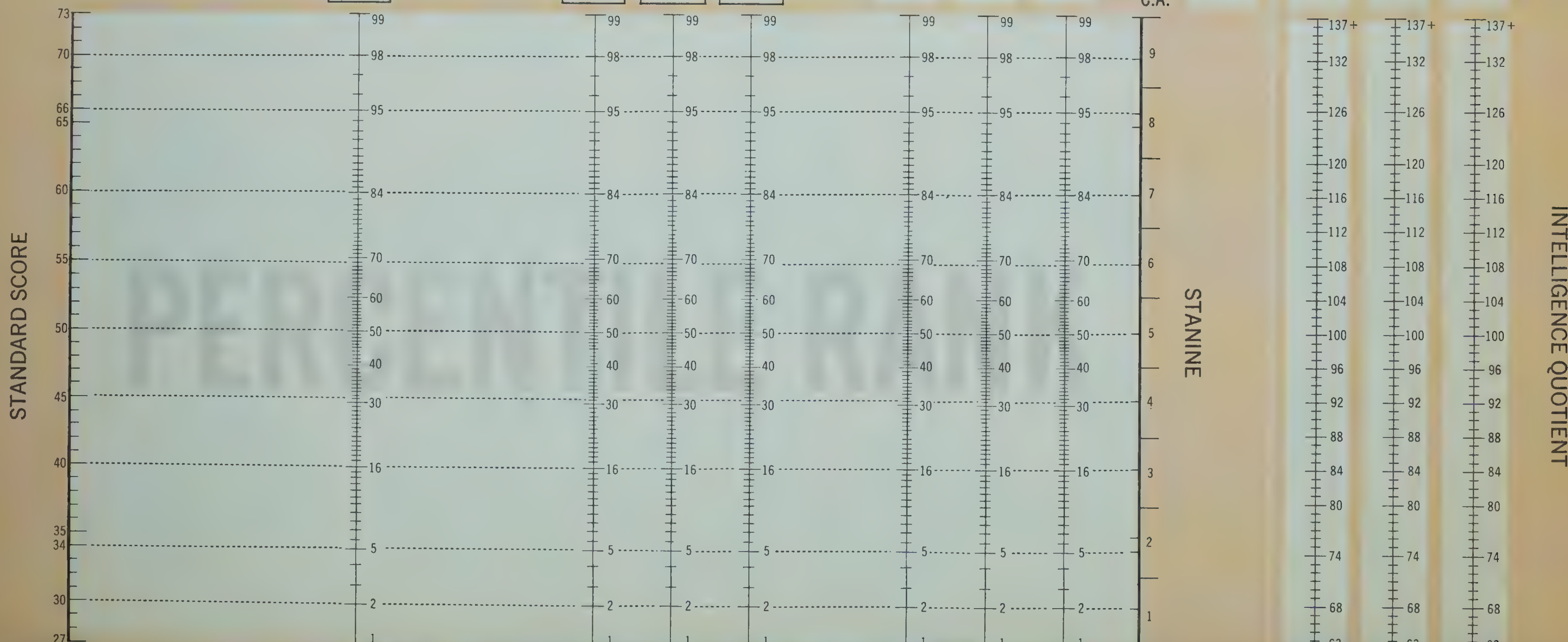
Date of Test .... (Year) (Month) (Day)

Date of Birth .... (Year) (Month) (Day)

C.A. .... (Years) (Months) ( ) (Total Mos.)

TEST/FACTOR	1. OPPOSITES	2. SIMILARITIES	3. ANALOGIES	**I. LOGICAL REASONING**	4. NUMERICAL VALUES	5. NUMBER PROBLEMS	**II. NUMERICAL REASONING**	**III. VERBAL CONCEPTS** (6. VERBAL COMPREHENSION)	**IV. MEMORY** (7. DELAYED RECALL)	LANGUAGE (Tests 5, 6, 7)	NON-LANGUAGE (Tests, 1, 2, 3, 4)	TOTAL	I.S.I.†
POSSIBLE SCORE	12	12	12	36	14	10	24	25	15	50	50	100	
RAW SCORE													ACTUAL G.P.
PERCENTILE*													GRADE C.A.

	LANGUAGE	NON-LANGUAGE	TOTAL	
				M.A.‡
				RAW SCORE
				I.Q.‡



*Unless otherwise indicated, national norms appropriate for pupil's chronological age are used.

†Intellectual Status Index; see Manual.

‡Must be obtained from table in Manual.

APPENDIX D

ONE-WAY ANALYSIS OF VARIANCE

ONE WAY ANOVA

Variable 1 Total Score on the Fast-Cosens Auditory Discrimination Test (266)

Group	Number	Mean	Variance	S.Dev.
1	40.	223.9000	417.0513	20.4218
2	40.	231.2750	294.2307	17.1532
3	40.	239.2750	156.4872	12.5095
4	40.	243.4500	78.3846	8.8535
Total	160.	234.4750	287.0156	16.9415

Homogenity of Variance Test CHISQ = 28.2570 Probability = 0.0000

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.90250000E 04	3008.33	3.	12.72	0.000003
Error	0.36898000E 05	236.53	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.2081	0.0003	0.0000
2	0.2081	1.0000	0.1487	0.0071
3	0.0003	0.1487	1.0000	0.6888
4	0.0000	0.0071	0.6888	1.0000

....

Variable 2 Stop-Stop Contrasts (24)

Group	Number	Mean	Variance	S.Dev.
1	40.	18.3000	14.4210	3.7975
2	40.	19.7500	13.4744	3.6707
3	40.	20.5000	8.4103	2.9000
4	40.	20.5750	6.6612	2.5809
Total	160.	19.7813	11.3083	3.3628

Homogenity of Variance Test CHISQ = 7.7681 Probability = 0.0511

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.13366406E 03	44.55	3.	4.15	0.007351
Error	0.16756797E 04	10.74	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.2749	0.0322	0.0246
2	0.2749	1.0000	0.7898	0.7372
3	0.0322	0.7898	1.0000	0.9997
4	0.0246	0.7372	0.9997	1.0000

....

Variable 3 Nasal-Nasal Contrasts (11)

Group	Number	Mean	Variance	S.Dev.
1	40.	8.3750	3.1635	1.7786
2	40.	8.7500	3.5769	1.8913
3	40.	9.4500	3.0231	1.7387
4	40.	9.8750	1.4455	1.2023
Total	160.	9.1125	3.0749	1.7535

Homogenity of Variance Test CHISQ = 8.5189 Probability = 0.0364

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.54824219E 02	18.27	3.	6.52	0.000355
Error	0.43715234E 03	2.80	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.8004	0.0447	0.0016
2	0.8004	1.0000	0.3247	0.0319
3	0.0447	0.3247	1.0000	0.7320
4	0.0016	0.0319	0.7320	1.0000

....

Variable 4 Semivowel-Lateral Contrasts (8)

Group	Number	Mean	Variance	S.Dev.
1	40.	6.8750	1.1891	1.0905
2	40.	7.0500	1.3821	1.1756
3	40.	7,5000	0.7179	0.8473
4	40.	7.6250	0.3429	0.5856
Total	160.	7.2625	0.9811	0.9905

Homogenity of Variance Test CHISQ = 20.0192 Probability = 0.0002

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.15324219E 02	5.11	3.	5.63	0.001097
Error	0.14165234E 03	0.91	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.8790	0.0384	0.0075
2	0.8790	1.0000	0.2203	0.0676
3	0.0384	0.2203	1.0000	0.9514
4	0.0075	0.0676	0.9514	1.0000

....

Variable 5 Fricative-Fricative Contrasts (48)

Group	Number	Mean	Variance	S.Dev.
1	40.	38.7000	32.3697	5.6894
2	40.	41.3750	18.5481	4.3067
3	40.	43.6000	7.0176	2.6491
4	40.	44.1250	5.7019	2.3879
Total	160.	41.9500	20.0979	4.4831

Homogenity of Variance Test CHISQ = 37.8471 Probability = 0.0000

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.73381250E 03	244.60	3.	15.38	0.000001
Error	0.24818125E 04	15.91	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.0325	0.0000	0.0000
2	0.0325	1.0000	0.1058	0.0261
3	0.0000	0.1058	1.0000	0.9509
4	0.0000	0.0261	0.9509	1.0000

Variable 6 Affricate-Fricative Contrasts (16)

Group	Number	Mean	Variance	S.Dev.
1	40.	13.5750	4.4559	2.1109
2	40.	14.0000	5.4359	2.3315
3	40.	14.7250	2.7687	1.6639
4	40.	15.2000	1.3437	1.1592
Total	160.	14.3750	3.8094	1.9518

Homogenity of Variance Test CHISQ = 19.7247 Probability = 0.0002

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.63343750E 02	21.11	3	6.03	0.000655
Error	0.54615625E 03	3.50	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.7936	0.0602	0.0024
2	0.7936	1.0000	0.3941	0.0452
3	0.0602	0.3941	1.0000	0.7320
4	0.0024	0.0452	0.7320	1.0000

Variable 7 Stop-Fricative Contrasts (23)

Group	Number	Mean	Variance	S.Dev.
1	40.	19.3000	7.1390	2.6719
2	40.	20.6750	6.5845	2.5660
3	40.	21.6000	1.9390	1.3925
4	40.	21.5000	1.1282	1.0622
Total	160.	20.7687	4.9409	2.2228

Homogenity of Variance Test CHISQ = 42.6408 Probability = 0.0000

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.13568750E 03	45.23	3.	10.78	0.000005
Error	0.65481250E 03	4.20	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.0323	0.0000	0.0001
2	0.0323	1.0000	0.2575	0.3589
3	0.0000	0.2575	1.0000	0.9973
4	0.0001	0.3589	0.9973	1.0000

....

Variable 8 Semivowel-Semivowel Contrasts (3)

Group	Number	Mean	Variance	S.Dev.
1	40.	2.4000	0.4000	0.6325
2	40.	2.5000	0.5641	0.7511
3	40.	2.7000	0.3180	0.5639
4	40.	2.8000	0.1641	0.4051
Total	160.	2.6000	0.3775	0.6144

Homogenity of Variance Test CHISQ = 14.3682 Probability = 0.0024

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.39997559E 01	1.33	3	3.69	0.013333
Error	0.56400391E 02	0.36	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.9069	0.1780	0.0345
2	0.9069	1.0000	0.5311	0.1780
3	0.1780	0.5311	1.0000	0.9069
4	0.0345	0.1780	0.9069	1.0000

....

Variable 9 Voiceless Sound Contrasts (67)

Group	Number	Mean	Variance	S.Dev.
1	40.	55.5750	55.7901	7.4693
2	40.	59.1500	41.0048	6.4035
3	40.	61.7500	17.6795	4.2047
4	40.	62.2750	10.2580	3.2028
Total	160.	59.6875	37.4397	6.1188

Homogenity of Variance Test CHISQ = 31.7866 Probability = 0.0000

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.11260000E 04	375.33	3.	12.04	0.000003
Error	0.48644375E 04	31.18	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.0457	0.0000	0.0000
2	0.0457	1.0000	0.2318	0.1041
3	0.0000	0.2318	1.0000	0.9812
4	0.0000	0.1041	0.9812	1.0000

....

Variable 10 Voiced Sound Contrasts (66)

Group	Number	Mean	Variance	S.Dev.
1	40.	51.9500	64.4599	8.0287
2	40.	54.9500	57.2292	7.5650
3	40.	58.3250	33.0465	5.7486
4	40.	59.4250	14.2532	3.7753
Total	160.	56.1625	49.8245	7.0586

Homogenity of Variance Test CHISQ = 23.3900 Probability = 0.0000

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.13813125E 04	460.44	3	10.90	0.000005
Error	0.65905000E 04	42.25	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.2390	0.0004	0.0000
2	0.2390	1.0000	0.1499	0.0264
3	0.0004	0.1499	1.0000	0.9024
4	0.0000	0.0264	0.9024	1.0000

....

Variable 11 Initial Sound Contrasts (39)

Group	Number	Mean	Variance	S.Dev.
1	40.	31.8000	17.2932	4.1585
2	40.	33.7250	11.3334	3.3665
3	40.	35.1500	7.2081	2.6848
4	40.	35.6000	4.6573	2.1581
Total	160.	34.0687	12.0647	3.4734

Homogenity of Variance Test CHISQ = 18.0411 Probability = 0.0004

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.35112500E 03	117.04	3.	11.56	0.000003
Error	0.15791875E 04	10.12	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.0665	0.0001	0.0000
2	0.0665	1.0000	0.2643	0.0780
3	0.0001	0.2643	1.0000	0.9401
4	0.0000	0.0780	0.9401	1.0000

....

Variable 12 Medial Sound Contrasts (33)

Group	Number	Mean	Variance	S.Dev.
1	40.	27.8500	15.3622	3.9195
2	40.	28.4500	17.6901	4.2060
3	40.	30.9750	5.7180	2.3912
4	40.	31.4000	2.5030	1.5821
Total	160.	29.6687	12.4343	3.5262

Homogenity of Variance Test CHISQ = 41.2756 Probability = 0.0000

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.37987500E 03	126.62	3.	12.27	0.000004
Error	0.16096250E 04	10.32	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.8736	0.0005	0.0001
2	0.8736	1.0000	0.0076	0.0011
3	0.0005	0.0076	1.0000	0.9502
4	0.0001	0.0011	0.9502	1.0000

....

Variable 13 Final Sound Contrasts (61)

Group	Number	Mean	Variance	S.Dev.
1	40.	47.8750	70.8301	8.4161
2	40.	41.9250	48.1763	6.9409
3	40.	53.9500	27.6394	5.2573
4	40.	54.7000	16.3189	4.0397
Total	160.	52.1125	46.7388	6.8366

Homogenity of Variance Test CHISQ = 22.4670 Probability = 0.0001

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.11224375E 04	374.15	3.	9.18	0.000015
Error	0.63555625E 04	40.74	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.0486	0.0006	0.0001
2	0.0486	1.0000	0.5710	0.2901
3	0.0006	0.5710	1.0000	0.9643
4	0.0001	0.2901	0.9643	1.0000

....

Variable 14 Like Word-Pairs (133)

Group	Number	Mean	Variance	S.Dev.
1	40.	116.3750	101.2660	10.0631
2	40.	117.1750	61.6490	7.8517
3	40.	119.2000	41.8702	6.4707
4	40.	121.7500	34.6026	5.8824
Total	160.	118.6250	62.6563	7.9156

Homogenity of Variance Test CHISQ = 13.4846 Probability = 0.0037

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.68900000E 03	229.67	3.	3.84	0.010984
Error	0.93370000E 04	59.85	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.9752	0.4483	0.0245
2	0.9752	1.0000	0.7129	0.0764
3	0.4483	0.7129	1.0000	0.5389
4	0.0245	0.0764	0.5389	1.0000

....

Variable 15 Unlike Word-Pairs (133)

Group	Number	Mean	Variance	S.Dev.
1	40.	107.5250	225.2420	15.0081
2	40.	114.1000	180.7724	13.4452
3	40.	120.0750	87.8798	9.3744
4	40.	121.7000	40.1266	6.3346
Total	160.	115.8500	161.2656	12.6990

Homogenity of Variance Test CHISQ = 30.6441 Probability = 0.0000

Analysis of Variance

Source	SS	MS	DF	F	P
Groups	0.49770000E 04	1659.00	3.	12.43	0.000002
Error	0.20826000E 05	133.50	156.		

Probability Matrix for Scheffé Multiple Comparison of Means

	1	2	3	4
1	1.0000	0.0951	0.0001	0.0000
2	0.0951	1.0000	0.1527	0.0376
3	0.0001	0.1527	1.0000	0.9410
4	0.0000	0.0376	0.9410	1.0000